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Management of breast cancer in the Medicaid population

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MANAGEMENT OF BREAST CANCER IN THE MEDICAID POPULATION

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ABSTRACT

Breast cancer is the second most common cancer and the second leading cause of cancer-related death among women. The current project examined some key issues important for effective breast cancer management in the Medicaid population. Medicaid is one the largest healthcare insurance systems in the US providing coverage to more than 60 million low-income individuals. As a part of this project, three studies were conducted. The first study determined the healthcare burden associated with breast cancer in the form of healthcare use (inpatient, outpatient, and emergency room [ER] visits) and costs associated with the condition in the Medicaid population. Significant healthcare burden was observed as the all-cause inpatient, outpatient, and ER visits and the total all-cause costs were found to be significantly higher among women with breast cancer as compared to women without breast cancer. The second study determined the impact of pre-existing mental illness on guideline-consistent breast cancer treatment and breast cancer-related healthcare use among Medicaid enrollees diagnosed with breast cancer. Negative association was observed between pre-existing mental illness and guideline-consistent breast cancer treatment and breast cancer-related outpatient visits indicating treatment disparities among women with breast cancer with pre-existing mental illnesses. The third study determined factors associated with repeat mammography screening in the Medicaid population. Recipient characteristics including age, race, number of outpatient visits during the study period, number of emergency room visits during the study period, use of hormone replacement therapy, and routine cervical cancer screening significantly impacted receipt of repeat mammography screening. The

findings of this project could be useful to Medicaid program planners in designing strategies aimed at reducing disparities in breast cancer-related healthcare in the Medicaid population.

LIST OF ABBREVIATIONS AND SYMBOLS

ACOG	American Congress of Obstetricians and Gynecologists
ACR	American College of Radiology
ACS	American Cancer Society
AJCC	American Joint Committee on Cancer
AI	Aromatase inhibitor
AIRR	Adjusted incident rate ratio
AMA	American Medical Association
ANOVA	Analysis of variance
AOR	Adjusted odds ratio
BSE	Breast self-examination
CA	Carcinoma antigen
CBE	Clinical breast examination
CCI	Charlson comorbidity index
CDC	Centers for Disease Control and Prevention
CEA	Carcinoembryonic antigen
CMS	Centers for Medicare and Medicaid services
CPT-4	Current procedural terminology 4^{th} edition
DUA	Data use agreement
EBCTCG	Early Breast Cancer Trialists' Collaborative Group
ER-positive	Estrogen receptor positive

ER	Emergency room
FIPS	Federal Information Processing Standard
FFS	Fee-for-service
GLM	Generalized linear model
HCPCS	Healthcare Common Procedure Coding System
HER2	Human epidermal growth factor 2
HMO	Health maintenance organization
HRT	Hormone replacement therapy
ICD-9-CM	International Classification of Diseases, ninth revision, clinical modification
IRB	Institutional review board
KFF	Kaiser Family Foundation
MAX	Medicaid analytic extract
MRI	Magnetic resonance imaging
NAFTA	North American Fareston vs. Tamoxifen Adjuvant
NCCN	National Comprehensive Cancer Network
NDC	National drug code
NIH	National Institute of Health
NS	Non-significant
NSABP	National Surgical Adjuvant Breast and Bowel Project
PAI-1	Plasminogen activator inhibitor
PR	Progesterone receptor
ResDAC	Research Data Assistance Center

SAS	Statistical Analysis System
SBI	Society of Breast Imaging
Sig	Significant
TNM	Tumor, regional lymph nodes, and distant metastases
USPSTF	United States Preventive Services Task Force
uPA	Urokinase plasminogen activator
US	United States
USDA	United States Department of Agriculture

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CHAPTER 1

INTRODUCTION

Overview of breast cancer

Breast cancer is defined as the uncontrolled or abnormal growth of cells within the breast. It is one of the oldest forms of cancer in humans, with records of breast cancer cases dating back to 1600 BC (Russo and Russo, 1995). The known risk factors for breast cancer include early age at menarche, late age at menopause and first child birth, family history of breast cancer, benign breast disease, use of hormone replacement therapy, nulliparity, physical inactivity, poverty, inadequate education, alcohol intake, and lack of health insurance (Gail et al., 1989, Lambe et al., 1996, Burke et al., 1997, Collaborative Group on Hormonal Factors in Breast Cancer, 1997, Smith-Warner et al., 1998, Grenall and Wood, 2000, Chlebowski et al., 2003, Buchholz, 2009). Symptoms of breast cancer include breast lump, breast swelling or thickening, breast skin irritation, flakiness or redness around the nipple, blood discharge from nipple, breast size change, and pain in the breast (Osteen, 2001).

Types of breast cancer

Breast cancer is generally categorized in terms of its histology, hormone receptor status, and expression of tumor markers. In terms of tumor histology, the two most common types of breast

cancer are ductal carcinoma and lobular carcinoma. The ductal carcinomas start inside the milk ducts in the breast. The lobular carcinomas start in the lobules, which are the milk producing glands present at the end of milk ducts. Each of these can be subdivided into non-invasive carcinomas (in situ), which remain confined to the point of origin, and invasive carcinomas, which spread to the other tissues of the breast. The ductal and lobular carcinomas together account for 90% of the breast cancer cases (Li et al., 2005). Other less common histological types of breast cancer include inflammatory breast cancer, Paget's disease of the nipple, and phyllodes tumor. Inflammatory breast cancers involve reddening and swelling of the breast rather than presence of an observable lump. In Paget's disease of the nipple, the cancer cells develop in and around the nipple. Phyllodes tumors start in the connective tissue of the breast. Based on the presence of receptors for hormones estrogen and progesterone on the breast cancer cells, breast cancers can be classified as estrogen or progesterone receptor (ER/PR) positive or negative. Presence of tumor markers such as human epidermal growth factor 2 (HER2), carcinoma antigen (CA) 15-3, CA 27.29, carcinoembryonic antigen (CEA), urokinase plasminogen activator (uPA), and plasminogen activator inhibitor (PAI-1) in blood or urine is also used to classify breast cancer (Li et al., 2005).

Stages of breast cancer

The extent of breast cancer at the time of diagnosis is codified using breast cancer staging systems. The most commonly used breast cancer staging system among clinicians is the primary tumor, regional lymph nodes, and distant metastases (TNM) system developed by the American Joint Committee on Cancer (AJCC). The TNM system classifies breast cancer into stages 0 to IV in the order of increasing severity. In stage 0, cancer cells are still within the ducts or lobules

and have not spread to the surrounding fatty breast tissue or to lymph nodes. Stage I is further classified into IA and IB. In stage IA, the size of the tumor is equal or less than 2 centimeters (cm) and the tumor is restricted within the breast. In stage IB, small clusters of breast cancer cells are found in the lymph nodes with no tumor or a tumor 2 cm or smaller in the breast. Stage II breast cancer is also classified into IIA and IIB. Stage IIA is characterized by presence of breast cancer in the lymph nodes with no tumor or a tumor 2 cm or smaller in the breast or a tumor 2-5 cm in size in the breast that has not spread to the lymph nodes. In stage IIB, the tumor is 2-5 cm in size and has spread to 1 to 3 axillary lymph nodes or to lymph nodes surrounding the breastbone, or the tumor is greater than 5 cm and the spread has not occured to the lymph nodes. Stage III breast cancer consists of subcategories of stage IIIA, IIIB, and IIIC. In stage IIIA, the tumor is greater than 5 cm in size and has spread to 1 to 3 axillary lymph nodes or lymph nodes surrounding the breastbone, or the tumor is not present in the breast, but is present in 4-9 axillary lymph nodes or lymph nodes near the breastbone. Stage IIIB cancer is characterized by tumor that has spread to the chest wall or the skin of the breast and up to 9 axillary lymph nodes or lymph nodes surrounding the breastbone, with presence of a swelling or ulcer. In stage IIIC, the cancer has spread to the chest wall or the skin of the breast and 10 or more axillary lymph nodes or lymph nodes surrounding the breastbone or those above or below the collar bone, with presence of a swelling or ulcer. Stage IV is the terminal stage of breast cancer in which the cancer has spread to the other organs of the body such as bones, lungs, liver, or the brain (Flemming et al., 1997, National Cancer Institute).

Occurrence of breast cancer in the US

The incidence rates of breast cancer in the US rose significantly between 1930s and 1990s (Glass and Hoover, 1988, Glass et al., 2007). The increase in breast cancer incidence during this period was attributed to various factors, including change in reproductive profiles of women, introduction of mammography screening, and increasing use of hormone replacement therapy (HRT) for the treatment of menopause (Feuer and Wun, 1992, Glass et al., 2007). The breast cancer incidence rates declined in the early 2000s (Glass et al., 2007, Jemal et al., 2007, Ravdin et al., 2007). It has been argued that the principal factor behind this decline is the reduction in the use of HRT due to the Women's Health Initiative report, which suggested an association between long term use of HRT and breast cancer (Clarke et al., 2006). The decline in mammography screening rates in the early 2000s has also been considered as a contributing factor to the decrease in the breast cancer incidence rates (Breen et al., 2007, Glass et al., 2007). The breast cancer incidence rates have been found to be stable post the decline observed in the early 2000s (Glass et al., 2007, DeSantis et al., 2011).

The prevalence of breast cancer has increased over the years due to factors such as improvement in breast cancer treatment and early detection of breast cancer owing to increased mammography screening rates (Alacacioglu et al., 2009, Breast cancer facts and figures 2011-2012). There were nearly 3 million breast cancer survivors in the US as of January 01, 2012. The number of women with breast cancer is expected to increase to nearly 3.8 million by the calendar year 2022 (Siegel et al., 2012).

Economic burden of breast cancer

Breast cancer is associated with a significant economic burden. The healthcare costs in patients with breast cancer have been found to be significantly higher than those in patients with other

ailments (Sasser et al., 2005, Barron et al., 2008, Fu et al., 2012). In their study involving beneficiaries of five managed care plans in the US, Barron et al. (2008) found average monthly all-cause direct medical costs of $4,421 in patients with breast cancer as compared to $3,352 in patients with other ailments. The costs of treatment of breast cancer vary by treatment phase. In general, the per unit time costs incurred during terminal phase are higher than those incurred during initial and continuing phases (Fireman et al., 1997, Warren et al., 2002). In a study involving breast cancer patients enrolled in Kaiser Permanante medical care program during 1987-1991, Fireman et al. (1997) found the six-monthly costs of initial, continuing, and terminal care to be $14,737, $2,245, and $18,406 respectively. Continuing care accounts for the greatest proportion of the lifetime costs due to high survival rates of breast cancer patients (Mariotto et al, 2011). The lifetime per patient direct medical costs of breast cancer have been estimated to be between $20,000 and $100,000 (Baker et al., 1991, Barnett et al., 1997, Lamerato et al., 2006, Campbell et al., 2009). The total national annual treatment costs of breast cancer in the US have been estimated to be roughly $16.5 billion (Mariotto et al., 2011). The annual lost productivity costs of breast cancer in the US have been reported to be nearly $11 billion (Bradley et al., 2008).

Treatment of breast cancer

The treatment of breast cancer has improved significantly over the last couple of decades (ACS). Existing treatment modes for breast cancer include surgery, radiation therapy, and adjuvant systemic therapies such as chemotherapy, endocrine therapy, and targeted therapy. Surgery is the primary mode of treatment for breast cancer. Some of the aggressive surgical breast cancer therapies include radical mastectomy, modified radical mastectomy, and total mastectomy.

Radical mastectomy consists of removal of the whole breast, the lymph nodes, and the skin overlying the breast, whereas modified radical mastectomy involves removal of the whole breast that has cancer and many of the lymph nodes under the arm. Total mastectomy consists of removal of the whole breast that has cancer but not the auxiliary body parts. A relatively less aggressive surgical breast cancer treatment regimen is breast-conserving surgery, a procedure performed to remove the cancer but not the breast itself. Examples of breast conserving surgery include lumpectomy, quadrantectomy, and segmental mastectomy. While lumpectomy involves removal of the tumor lump in the breast, quadrantectomy consists of removal of one quarter of the breast. Segmental mastectomy involves removal of the tumor, the surrounding breast tissue, and the lining over the chest muscles below the tumor. Radiation therapy involves the use of high-energy x-rays or gamma rays to kill the cancer cells or keep them from growing (NCI).

Radical mastectomy was the standard of breast cancer surgical care until the 1960s (Pilnik, 2003). However, several randomized controlled studies conducted to evaluate the effectiveness of various breast cancer treatment regimens have shown that survival in breast cancer is not associated with the aggressiveness of the local therapy. The National Surgical Adjuvant Breast and Bowel Project (NSABP) B-04 randomized controlled trial, which involved patients with operable node negative breast cancer in the US and Canada, found no significant differences in long term survival among patients undergoing radical mastectomy, total mastectomy, or total mastectomy with adjuvant radiotherapy (Fisher et al., 2006). The NSABP B-06 trial compared the effectiveness of total mastectomy alone, lumpectomy plus axillary lymph node dissection, and lumpectomy with axillary lymph node dissection and radiation therapy. No significant differences were observed in terms of disease-free and overall survival between the three treatment regimens. However, an additional benefit of radiation therapy was

observed in the study with reduced instances of locoregional recurrence observed in patients undergoing lumpectomy with axillary lymph node dissection and radiation therapy as compared to those undergoing lumpectomy and axillary lymph node dissection (3% vs. 9%) (Fisher et al., 2002). Overgaard et al (1997) studied the effect of radiation therapy after mastectomy and adjuvant chemotherapy in premenopausal women with stage II or III breast cancer. Post-mastectomy radiation therapy was associated with 23% reduction in locoregional recurrence and 9% improvement in overall survival. In a similar study, Overgaard et al. (1999) observed 27% reduction in locoregional recurrence, 12% improvement in disease-free survival, and 9% improvement in overall survival due to use of radiation therapy after mastectomy in postmenopausal women with stage II or III breast cancer. A meta-analysis of 78 randomized controlled trials conducted by Clarke et al. (2005) revealed that use of radiotherapy post breast conserving surgery or mastectomy was associated with a nearly 20% reduction in locoregional recurrence and 5% reduction in breast cancer-specific mortality. Owing to findings from such studies, breast conserving surgery with radiation therapy or total mastectomy is currently the recommended primary treatment regimen for breast cancer (NIH guidelines for the treatment of breast cancer, 1990, National Comprehensive Cancer Network [NCCN], 2006, Maughan et al., 2011). Post-mastectomy radiation therapy is recommended in patients with tumors five centimeters (cm) or more in size or tumors that have spread to four or more axillary lymph nodes (NCCN, 2006, Maughan et al., 2011).

Systemic adjuvant therapies such as chemotherapy, endocrine therapy, and tissue-targeted therapy are crucial for preventing the growth of existing tumor, reducing the recurrence rate, and improving breast cancer-specific survival. The choice of systemic adjuvant therapies depends on hormone receptor status, menopausal status, HER2 expression, and lymph node

involvement. Consensus guidelines recommend chemotherapies in patients with lymph node node-positive breast cancer or those with tumors larger than 1 cm (NCCN, 2006, Maughan et al., 2011). It has been reported that chemotherapies are more beneficial in hormone receptor-negative breast cancers as compared to hormone receptor-positive breast cancers (Goldhirsch et al., 2007). Induction chemotherapy aimed at reducing the tumor size is generally administered prior to surgery in stage III breast cancer patients. Some of the common chemotherapy drugs include anthracyclines (e.g., doxorubicin and epirubicin), taxanes (e.g., docetaxel and paclitaxel), cyclophosphamide, and capecitabine. Taxanes and anthracyclines are the preferred chemotherapy drugs since lower cancer recurrence rates and higher disease-specific survival have been observed in patients on anthracycline or taxane regimens as compared to other chemotherapy drugs (Maughan et al., 2011). In addition, use of anthracycline and taxane has been associated with higher disease-specific and overall survival as compared to use of anthracycline only (De Laurentiis, 2008). Endocrine therapies such as selective estrogen receptor modulators (e.g., Tamoxifen) and aromatase inhibitors (e.g., anastrazole, letrozole, and exemestane) are recommended for use in patients with ER positive breast cancer (NCCN, 2006). A meta-analysis of 12 randomized controlled trials showed that five years of tamoxifen therapy reduces the breast cancer mortality rate by 31% irrespective of age, progesterone receptor status, or other tumor characteristics (Early Breast Cancer Trialists' Collaborative Group [EBCTCG]). Aromatase inhibitors (AIs) have been found to be more effective in reducing the disease-free survival rates as compared to tamoxifen (Coates et al., 2007), because of which they are considered as a first-line adjuvant therapy in postmenopausal women with ER-positive breast cancer. AIs have also been found to be effective in reducing disease-free survival rates as compared to placebo in postmenopausal women who have completed five years of tamoxifen

therapy (Goss et al., 2003). In spite of their proven effectiveness over tamoxifen, AIs are not usually recommended in premenopausal women since they have been found to be less effective in inhibiting ovarian estrogen production (Fabian, 2007). Tissue-targeted therapies such as trastuzumab are recommended in women with HER2-positive breast cancer (NCCN, 2006). Lower risk of death and higher disease-free survival has been observed among HER2- positive breast cancer patients on trastuzumab and chemotherapy as compared to patients on chemotherapy only (Romond et al., 2005, Smith et al., 2007).

Factors affecting guideline-consistent breast cancer treatment

Treatment compliant with the established consensus guidelines for the treatment of breast cancer is important for optimal health outcomes in breast cancer patients (Herbert-Croteau et al., 2004, Maskarinec et al., 2011). Various patient and healthcare-related characteristics have been found to be associated with receipt of guideline-consistent breast cancer treatment. Several studies have found increasing age to be negatively associated with guideline-consistent breast cancer treatment (Ballard-Ballash et al., 1996, Haggstorm et al., 2005, Anderson et al., 2008, Chagpar et al., 2008, Rosato et al., 2009, Jagsi et al., 2010, Chien et al., 2012). For example, in their study of elderly Medicare beneficiaries with breast cancer, Haggstorm et al. (2005) found that women aged 70-74 years were 18% less likely and women aged 75-79 years were 60% less likely to receive recommended regimen of radiation therapy after breast conserving surgery as compared to those aged 65-69 years. The treatment of breast cancer has been found to vary with race. White women have been found to be more likely to receive guideline-consistent breast cancer treatment as compared to ethnic minorities such as African American women and Hispanic women (Haggstorm et al., 2005, Voti et al., 2006, Smith et al., 2010). Prior studies have found a

positive association between possession of health insurance and receipt of guideline-consistent breast cancer treatment (Voti et al. 2006, Freedman et al., 2011). Location of residence has been found to be an important predictor of guideline-consistent breast cancer treatment. A study of elderly Medicare beneficiaries with breast cancer revealed that women living in rural areas were 25% less likely to receive radiation therapy after breast conserving surgery as compared to women in metropolitan areas (Haggstorm et al., 2005). Negative association between number of comorbidities and receipt of guideline-consistent breast cancer treatment has been observed in prior studies (Ballard-Barbash et al., 1996, Rosato et al., 2009, Jagsi et al., 2010). Factors reflective of health services use, including use of mammography before breast cancer diagnosis and greater number of physician visits in the 12 months prior to diagnosis, have been reported to be positively associated with receipt of recommended regimen of radiation therapy after breast cancer surgery (Smith et al., 2010).

Important hospital-level characteristics have been shown to affect receipt of guideline-consistent breast cancer treatment. Laliberte et al. (2005) reported that patients treated in hospitals with memberships in multiple National Cancer Institute (NCI)-funded research networks were 42% more likely to receive mastectomy and 60% more likely to receive breast conserving surgery with radiotherapy as opposed to breast conserving surgery only, as compared to hospitals without a membership in any NCI-funded research network. In their study involving women with local stage breast cancer in Florida, Voti et al. (2006) found 21% greater odds of receiving guideline-consistent treatment among women treated in non-teaching hospitals as compared to those treated in teaching hospitals. Hospital size has been found to positively impact receipt of guideline-consistent breast cancer treatment (Satariano et al., 1992, Grilli et al., 1994, Guadagnoli et al., 1998). For example, Guadagnoli et al. (1998) reported that breast

cancer patients treated in hospitals in Massachusetts with 100-249, 250-499, and 500 beds or more were 9.1, 6.5, and 7.9 times, respectively, more likely to receive radiotherapy after breast conserving surgery as compared to hospitals with less than 100 beds.

Healthcare access-related variables such as number of primary care physicians and number of radiologists in the healthcare service area have been shown to be positively associated with receipt of guideline-consistent treatment of breast cancer (Ballard-Ballash et al., 1996). Studies have also found caseload of attending physicians to positively impact receipt of guideline-consistent breast cancer treatment (Satariano et al., 1992, Goy et al., 1998, Neuner et al., 2004, Ingram et al., 2005). Surgeon specialty has been reported to be associated with receipt of radiation therapy after breast conserving surgery. Chagpar et al. (2008) studied the factors associated with the breast cancer treatment received by patients enrolled in the North American Fareston vs. Tamoxifen Adjuvant (NAFTA) trial. Surgical oncologists were found to be more likely to omit radiation therapy after breast conserving surgery as compared to general surgeons.

Impact of pre-existing mental illnesses on receipt of guideline-consistent breast cancer treatment

Pre-existing mental illness could be an important factor affecting breast cancer treatment. Due to health-related issues such as poor eating and sleeping habits, lack of exercise, indulgence in smoking, alcohol, and drug abuse, and impaired immune system, individuals with mental illnesses are more likely to develop comorbid physical conditions, including breast cancer (Kendrick, 1996, Osborn, 2001, Mitchell et al., 2009, McGuinty et al., 2012). These individuals also face challenges such as impaired communication skills, less motivation to undergo treatment, failure in follow-up care, and higher pain threshold due to which disparities in medical care are likely in these individuals (Lawrence and Kisely, 2010). Limited research currently

exists regarding the association between pre-existing mental illnesses and receipt of guideline-consistent breast cancer treatment. A thorough literature review yielded only one study in this regard. Goodwin et al. (2004) evaluated the effect of pre-existing depression on the treatment of breast cancer among elderly Medicare beneficiaries with breast cancer. The authors found that women with pre-existing depression were 19% more likely to receive treatment non-consistent with established breast cancer treatment guidelines (simple mastectomy or breast-conserving surgery plus adjuvant irradiation for Stage 0, modified radical mastectomy or breast-conserving surgery with axillary dissection and adjuvant irradiation for Stage I or II, and chemotherapy for Stages III or IV) as compared to women without pre-existing depression.

Breast Cancer Screening

Screening for breast cancer offers potential for early detection of breast cancer at an asymptomatic stage (Paskett and McLaughlin, 2011). Existing breast cancer screening modalities include mammography, clinical breast examinations (CBEs), breast self-examinations (BSEs), ultrasonography, and magnetic resonance imaging (MRI). Mammography consists of imaging of breast tissue using ionizing radiations such as X-rays for the purpose of identification of in situ cancers or cancers that are too small to detect on physical examination. Several randomized controlled trials have demonstrated that mammography screening is associated with mortality reduction in the range of 15-25% (Anderson et al., 1988, Chu et al., 1988, Tabar et al., 1992, Tabar et al., 1995, Roberts et al., 1990. Bjurstam et al., 1997). CBE is a physical examination of the breasts conducted by the healthcare provider for the purpose of detecting lumps or abnormalities. While no trials have been conducted for determining the efficacy of CBEs as a sole screening procedure, they have been found to be useful as an addition to

mammography screening (Oestreicher et al., 2005). Evidence regarding the effectiveness of BSEs as a screening procedure has been weak (Humphrey et al., 2002). A randomized trial conducted by Thomas et al. (2002) showed no reduction in breast cancer-related mortality due to BSEs. Ultrasonography is useful in detecting breast carcinomas underlying dense breast tissue. However, there is no evidence to support use of ultrasonography in population-based breast cancer screening programs (Teh et al., 1998, Ponhold et al., 2012). MRIs have high sensitivity as compared to screening mammography, especially in high risk women (Lawrence et al., 1998). However, the effectiveness of MRIs in breast cancer screening is questionable due to high false positive rates (Paskett and McLaughlin, 2011).

Breast cancer screening guidelines

Mammography is the most effective and the most commonly used screening modality for the detection of breast cancer (Rim and Chellman-Jeffers, 2008, Vinitha Sree et al., 2011). The current guidelines from ACS include yearly mammograms starting at age 40 until a woman is in good health (ACS). The United States Preventive Services Task Force (USPSTF) recommends biennial mammography for women aged 50 to 74 years. There has been a controversy associated with the USPSTF recommendations since there were no cancer specialists in the USPSTF panel, which issued the recommendations, and not all peer reviewed studies were considered while formulating the recommendations (Kopans, 2010, Woloshin and Schwartz, 2010, Hendrick et al., 2011, Catalona et al., 2012). Most of the other major medical organizations in the US such as the American College of Radiology (ACR), the American Medical Association (AMA), the Society of Breast Imaging (SBI), and the American Congress of Obstetricians and Gynecologists (ACOG) recommend annual mammography screening in women beginning at age 40 (Lee et al.,

2010). CBEs are recommended every 3 years for women in their 20s and 30s and every year for women aged 40 and over, and MRIs are recommended for women at high risk for breast cancer (women with a family history or a genetic tendency of breast cancer). However, with proven effectiveness in multiple controlled trials, mammography is generally the mainstay of breast cancer screening for average risk women (Lee et al., 2010).

Trends in mammography screening in the US

The initial recommendation for mammography screening was issued in 1983 (ACS). Since then, mammography has been widely adopted as a screening procedure in the US. In general, the mammography screening rates have been found to be higher among women aged 50-64 years, college graduates, women with a high income, women having a usual source of care, women possessing a private HMO insurance, women who were born in the US, married women, employed women, women having a good or better health status, and women who have a family or personal history of breast cancer (Kim and Jang, 2008, Slomiany et al., 2008, Breen et al., 2011). In terms of trends in mammography screening rates over time, studies have found that the rates increased from the mid 1980s until 2000, after which a decline was observed until 2005 (Breen et al., 2007, Chagpar et al., 2008, Zhou et al., 2010, Shi et al., 2011). The decline was more evident in women with high family incomes, women with a private non-HMO insurance, women who were born in the US, non-Hispanic white women, women without personal or family history of breast cancer, employed women, women having at least a high school diploma, and those who reported being in poor or fair health (Chagpar et al., 2008, Ryerson et al., 2008, Slomiany et al., 2008, Zhou et al., 2010, Breen et al., 2011, Shi et al., 2011). Possible reasons for the decline in mammography screening rates include decrease in the use of HRT in the early

2000s due to a Women's Health Initiative report suggesting an association between HRT and breast cancer, decrease in the number of mammography facilities between 2000 and 2003, increase in the number of women without a health insurance, increase in copayments for office visits, low reimbursements by insurers for mammography screenings, and increasing lawsuits against radiologists who read mammograms (Breen et al., 2007, Wolf et al., 2009). Recent studies have reported that the mammography screening rates have not declined after 2005 (Breen et al., 2011).

Factors associated with regular mammography screening

Several factors have been found to be associated with routine receipt of mammography screening. These factors can be broadly classified into socio-demographic factors, healthcare-related factors, and psychological factors.

Socio-demographic factors

Socio-demographic factors such as race/ethnicity, age, education, income, and marital status have been found to be important predictors of routine receipt of mammography. Several studies have reported that Caucasians are more likely to get regularly screened as compared to racial minorities such as African Americans, Asian Americans, and Hispanics (Song et al., 1998, Yood et al., 1999, Sabogral et al., 2001, Strzelczyk and Dignan, 2002). Higher education has been found to be positively associated with routine receipt of mammography (Strzelczyk and Dignan, 2002, Rahman et al., 2003, Raucher et al., 2005, Litaker et al., 2007). For example, in their study of mammography screening behaviors of women residing in the Denver, Colorado, Rahman et al. (2003) found that high school graduates were 11% more likely and college

graduates were 33% more likely to receive routine mammography screenings as compared to women who did not graduate high school. Prior studies have revealed that married women are more likely to get routinely screened as compared to single or divorced women (Yood et al., 1999, Coughlin et al., 2004, Borrayo et al., 2009). Residents in rural areas have been found to be less likely to get regularly screened as compared to residents in the urban areas. A study of mammography screening behaviors of elderly women in California reported that residence in urban areas was associated with 5% lesser odds of irregular mammography screening as compared to residence in rural areas (Sabogral et al., 2001). In terms of income, studies have found that individuals with higher income are more likely to undergo regular mammography than those with lower income (Phillips et al., 1998, Yood et al., 1999, Sabogral et al., 2001, Rakowski et al, 2006, Litaker et al., 2007). However, individuals within the lowest income categories may not be least likely to receive routine mammography screening. Rahman et al. (2006) studied the mammography screening behaviors of women aged 40 or more residing in Colorado from January 01, 1994 to December 31, 1998. Women with income between $15,000 and $24,999 had 16% lesser odds of receiving biennial mammograms as compared to those with incomes less than $15,000 (Rahman et al., 2003). Similar results were observed by Rakowski et al. (2006). In terms of association between age and mammography use, studies have found that women aged 40-49 years are less likely to routinely undergo mammography screening as compared to women aged 50-59 years. Further, studies have found that the likelihood of receipt of routine mammography is lower in older age groups as compared to women in the age group 50-59 years (Coughlin et al., 2004, Borrayo et al., 2009, Gierisch et al., 2010). Non-indulgence in smoking and indulgence in alcohol use have been associated with regular mammography screening (Coughlin et al., 2004, Rosenberg et al., 2005, Rakowski et al., 2006, Borrayo et al.,

2009). Positive association between family history of breast cancer and regular use of mammography screening has been reported in several studies (Lerman et al., 1990, Strzelczyk and Dignan, 2002, Bobo et al., 2004, Rosenberg et al., 2005, Borraryo et al., 2009, Gierisch et al., 2010, Vyas et al., 2012). A positive association between health status and regular mammography use has also been observed in previous studies (Bobo et al., 2004, Litaker et al., 2007).

Healthcare-related factors

Healthcare-related factors such as regular care from a healthcare provider, use of other preventive procedures, prior mammography or breast biopsy, and health insurance coverage play an important role in regular mammography screening. Having a visit to a physician and obstetricians/gynecologists has been found to be a major factor influencing regular mammography screening (Taylor et al., 1995, Coughlin et al., 2004, Wu et al., 2007). In addition, the frequency of visits has been found to positively affect mammography use. In their study involving women enrolled in a New York HMO, Barr et al. (2001) found that women with three or more visits to a gynecologist had greater odds of receiving regular mammograms than those having one or two visits. Prior studies have found a positive association between having a usual source of care and regular receipt of mammography (Bobo et al., 2004, Rakowski et al., 2006, Litaker et al., 2007). For example, in their analysis of the 2003 Health Information National Trends Survey, Rakowski et al. (2006) reported that women without a usual source of care were 69% less likely to receive repeat screening mammography within two years of the index mammogram as compared to women with a usual source of care. Regular mammography screening has also been found to be positively impacted by regular use of other preventive tests

such as cervical cancer screening tests, colorectal cancer screening tests, influenza shots, cholesterol tests, blood glucose exams, and gynecologic exams (Phillips et al., 1998, Cummings et al., 2000, Raucher et al., 2005, Rosenberg et al., 2006, Wu et al., 2007). A positive association has been observed between HRT use and adherence to mammography screening guidelines in previous studies (Bobo et al., 2004, Borrayo et al., 2009). Previous receipt of mammography or diagnostic procedures such as breast biopsy has been found to be positively associated with regular receipt of mammography (Song et al., 1998, Bobo et al., 2004). With most of the health insurances covering the cost of mammograms (CDC), it is not surprising that a positive association between possession of health insurance and routine mammography screening has been observed consistently in previous studies (Cummings et al., 2000, Strzelczyk and Dignan, 2002, Coughlin et al., 2004, Litaker et al., 2007). Previous studies have found factors related to healthcare access such as health maintenance organization (HMO) penetration rate, number of primary care physicians and obstetricians/gynecologists the area, and number of mammography screening facilities in the area to be positively associated with routine receipt of mammography screening (Phillips et al., 1998, Engelman et al. 2002, Baker et al., 2004, Benjamins et al., 2004, Litaker et al., 2007, Coughlin et al., 2008, Akinyemiju et al., 2012).

Psychological factors

Psychological factors such as perceived susceptibility towards breast cancer, perceived severity of breast cancer, and perceived benefits of mammography screening have been found to positively affect receipt of regular mammography screening (Lerman et al., 1990, Lee et al., 1995, Taylor et al., 1995, Halabi et al., 2000, Rakowski et al., 2006). Factors such as anxiety and embarrassment about screening and concern about cost have been found to negatively impact

regular mammography screening (Lerman et al., 1990, Maxwell et al., 1996). Positive association has been observed between knowledge about breast cancer, mammography, and mammography screening guidelines and receipt of routine mammography (Glanz et al., 1992, Miller and Champion, 1996, Vyas et al., 2012). Satisfaction with previous experience of mammography has also been found to positively impact regular mammography screening (Gierisch et al., 2009).

Need for the study

I. Need for determining the healthcare burden of breast cancer in the Medicaid population. Limited information currently exists about the healthcare burden of breast cancer in the Medicaid population. Medicaid is one of the largest health insurance systems in the US providing coverage to over 60 million individuals. Compared to other insured individuals, Medicaid enrollees have been found to have weaker socioeconomic and health-related characteristics. An understanding of the estimates of the healthcare burden of breast cancer is important to the policy-makers for making decisions about resource allocation. Only one study to date has determined the healthcare burden of breast cancer among Medicaid enrollees (Khanna et al., 2011). The study by Khanna et al. (2011) used data from West Virginia Medicaid fee-for-service system to study breast cancer burden among women 21-64 years of age. Though this study provided useful information regarding breast cancer burden among Medicaid enrollees, the fact that authors used single-state Medicaid data limited its generalizability.

Chapter 2 determined the breast cancer-related healthcare utilization among women with breast cancer in the national Medicaid population using multistate Medicaid medical and pharmacy administrative claims data. In addition, the incremental economic burden of breast

cancer in the Medicaid population was determined by comparing the healthcare use and costs of female recipients with breast cancer to those without breast cancer.

II. Need for determining the impact of pre-existing mental illnesses on the receipt of guideline-consistent breast cancer treatment and breast cancer-related healthcare utilization among Medicaid enrollees diagnosed with breast cancer.

It has been reported that up to 55% of the women with breast cancer do not receive recommended breast cancer treatments (Bloom et al., 2004, Landercasper et al., 2006, Foley et al., 2007, Worthington et al., 2008, Iyengar et al., 2010, Shirvani et al., 2011). An understanding of the factors affecting the receipt of high quality breast cancer treatment, consistent with the established standards of breast cancer care, is necessary for planning steps towards improving the treatment of breast cancer patients. While various individual and healthcare-related characteristics have been found to impact the receipt of guideline-consistent breast cancer treatment, scant literature currently exists about the association between pre-existing mental illnesses and receipt of guideline-consistent breast cancer treatment. The only study in this regard was conducted by Goodwin et al. (2004), who determined the association between pre-existing depression and receipt of guideline-consistent breast cancer treatment among elderly Medicare beneficiaries. While the work conducted by Goodwin et al. (2004) makes a significant contribution, only the impact of depression and not other mental illnesses was evaluated in the study. Moreover, the findings of this study may not be generalizable to younger patients with breast cancer. Pre-existing mental illnesses could also impact other important treatment-related outcomes, including healthcare utilization and costs, in breast cancer patients. However, no information is available in this area in the previous literature.

Chapter 3 in the current study addressed this gap in the literature by determining the impact of pre-existing mental illnesses on the receipt of receipt of guideline-consistent breast cancer treatment and breast cancer-related healthcare utilization among Medicaid enrollees diagnosed with breast cancer.

III. Need for determining the factors associated with use of repeat mammography screening among women enrolled in Medicaid.

Regular mammography screening has been found to be more effective in reducing morbidity and mortality associated with breast cancer as compared to irregular or no mammography screening (Freedman et al., 2003, Moss et al., 2006, Hellquist et al., 2010). However, less than half of the eligible women undergo regular mammography screening (Gierisch et al., 2009). An understanding of factors affecting regular breast cancer screening is necessary for the purpose of devising healthcare interventions aimed at increasing the routine mammography screening rates. Limited information is available regarding factors affecting routine mammography screening in the Medicaid population. In the past, Weir et al. (2011) and Bhanegaonkar et al. (2012) have determined the factors affecting routine mammography use among Medicaid enrollees belonging to certain states. However, a major limitation of these studies was the limited generalizability of their findings.

Chapter 4 in this study determined the factors affecting the use of repeat mammography screening in a multistate Medicaid population. Association between individual and neighborhood factors and repeat mammography screening was studied.

LIST OF REFERENCES

1) Akinyemiju TF, Soliman AS, Yassine M, Banerjee M, Schwartz K, Merajver S. Healthcare access and mammography screening in Michigan: a multilevel cross-sectional study. Int J Equity Health 2012;11:16.
2) Alacacioglu A, Yavuzsen T, Dirioz M, Yilmaz U. Quality of life, anxiety and depression in Turkish breast cancer patients and in their husbands. Med Oncol 2009;26:415-419.
3) American Cancer Society. What are the key statistics about breast cancer? Available at http://www.cancer.org/Cancer/BreastCancer/DetailedGuide/breast-cancer-key-statistics. Accessed July 17, 2012.
4) American Cancer Society. Breast cancer facts and figures 2011-2012. Available at: http://www.cancer.org/acs/groups/content/@epidemiologysurveilance/documents/document/acspc-030975.pdf. Accessed April 30, 2012.
5) American Cancer Society. Mammography guidelines 1983: background statement and update of cancer-related check-up guidelines for breast cancer detection in asymptomatic women age 40 to 49. CA 1983;33:255.
6) American Medical Association. Support given to mammography access for women older than 40. Available at http://www.ama-assn.org/amednews/m/2012/07/02/psg0702.htm. Accessed July 22, 2012.
7) Andersson I, Aspegren K, Janzon L, et al. Mammographic screening and mortality from breast cancer: the Malmo mammographic screening trial. BMJ 1988;297:943-948.
8) Anderson RT, Kimmick GG, Camacho F, Whitmire JT, Dickinson C, Levine EA, Balkrishnan R. Health system correlates of receipt of radiation therapy after breast-conserving surgery: a study of low-income Medicaid-enrolled women. Am J Manag Care 2008;14:644-652.
9) Ballard-Barbash R, Potosky AL, Harlan LC, Nayfield SG, Kessler LG. Factors associated with surgical and radiation therapy for early stage breast cancer in older women. J Natl Cancer Inst 1996;88:716-726.
10) Baker LC, Phillips KA, Haas JS, Liang SY, Sonneborn D. The effect of area HMO market share on cancer screening. Health Serv Res 2004;39:1751-1772.
11) Baker MS, Kessler LG, Urban N, et al. Estimating the treatment costs of breast and lung cancer. Med Care 1991;29:40-49.
12) Barnett A, Birnbaum H, Cremieux PY, et al. The costs of cancer to a major employer in the United States: a case-control analysis. Am J Manag Care 2000;6:1243-1251.
13) Barr JK, Franks AL, Lee NC, Herther P, Schachter M. Factors associated with continued participation in mammography screening. Prev Med 2001;33:661-667.
14) Barron JJ, Quimbo R, Nikam PT, Amonkar MM. Assessing the economic burden of breast cancer in a U.S. managed care population. Breast Cancer Res Treat 2008;109:367-377.
15) Benjamins MR, Kirby JB, Bond Huie SA. County characteristics and racial and ethnic disparities in the use of preventive services. Prev Med 2004;39:704-712.
16) Bhanegaonkar A, Madhavan SS, Khanna R, Remick RC. Declining mammography screening in a state Medicaid fee-for-service program: 1999-2008. J Womens Health 2012;21:821-829.
17) Bjurstam N, Bjorneld L, Duffy SW, et al. The Gothenburg breast screening trial: first results on mortality, incidence, and mode of detection for women ages 39–49 years at randomization. Cancer 1997;80:2091-2099.

18) Bloom BS, de Pouvourville N, Chhatre S, Jayadevappa R, Weinberg D. Breast cancer treatment in clinical practice compared to best evidence and practice guidelines. Br J Cancer 2004;90:26-30.
19) Bobo JK, Shapiro JA, Schulman J, et al. On-schedule mammography rescreening in the National Breast and Cervical Cancer Early Detection Program. Cancer Epidemiol Biomarkers Prev 2004;13:620-630.
20) Borrayo EA, Hines L, Byers T, et al. Characteristics associated with mammography screening among both Hispanic and non-Hispanic White women. J Women's Health 2009;18:1585-1594.
21) Bradley CJ, Yabroff KR, Dahman B, Feuer EJ, Mariotto A, Brown ML. Productivity costs of cancer mortality in the United States: 2000–2020. J Natl Cancer Inst 2008;100:1763-1770.
22) Breen NA, CroninK, Meissner HI et al. Reported drop in mammography. Cancer 2007;109:2405-2409.
23) Breen N, Gentleman JF, Schiller JS. Update on mammography trends: comparisons of rates in 2000, 2005, and 2008. Cancer 2011;117:2209-2218.
24) Buchholz TA. Radiation therapy for early-stage breast cancer after breast-conserving surgery. N Engl J Med 2009;360:63-70.
25) Burke W, Daly M, Garber J, et al. Recommendations for follow-up care of individuals with an inherited predisposition to cancer. II. BRCA1 and BRCA2. JAMA 1997;277:997-1003.
26) Campbell JD, Ramsey SD. The costs of treating breast cancer in the US. Pharmacoeconomics 2009;27:199-209.
27) Catalona WJ, D'Amico AV, Fitzgibbons WF, et al. What the U.S. preventive services task force missed in its prostate cancer screening recommendation. Ann Intern Med 2012;157:137-138.
28) Chagpar AB, McMasters KM, Scoggins CR, Martin RC, Thoene C, Edwards MJ. The use of radiation therapy after breast-conserving surgery in hormonally treated breast cancer patients is dependent on patient age, geographic region, and surgeon specialty. Am J Surg 2008;195:793.
29) Chagpar AB, Polk HC, McMasters KM. Racial trends in mammography rates: a population-based study. Surgery 2008;144:467-472.
30) Chien CR, Pan IW, Tsai YW, Tsai T, Liang JA, Buchholz TA, Tina Shih YC. Radiation therapy after breast-conserving surgery: does hospital surgical volume matter? A population-based study in Taiwan. Int J Radiat Oncol Biol Phys 2012;82:43-50.
31) Chlebowski RT, Hendrix SL, Langer RD, et al. Influence of estrogen plus progestin on breast cancer and mammography in healthy postmenopausal women: the Women's Health Initiative Randomized Trial. JAMA 2003;289:3243-3253. Collaborative Group on Hormonal Factors in Breast Cancer. Breast cancer and hormone replacement therapy: collaborative reanalysis of data from 51 epidemiological studies of 52,705 women with breast cancer and 108,411 women without breast cancer. Lancet 1997;350:1047-1059.
32) Chu KC, Smart CR, Tarone RE. Analysis of breast cancer mortality and stage distribution for the Health Insurance Plan clinical trial. J Natl Cancer Inst 1988;80:1125-1132.
33) Clarke M, Collins R, Darby S, Davies C, Elphinstone P, Evans E, Wang Y. Effects of radiotherapy and of differences in the extent of surgery for early breast cancer on local

recurrence and 15-year survival: an overview of the randomised trials. Lancet 2005;366:2087.
34) Clarke CA, Glaser SL, Uratsu CS, Selby JV, Kushi LH, Herrinton LJ. Recent declines in hormone therapy utilization and breast cancer incidence: clinical and population-based evidence. J Clin Oncol 2006;24:e49-e50.
35) Coates AS, Keshaviah A, Thürlimann B et al. Five years of letrozole compared with tamoxifen as initial adjuvant therapy for postmenopausal women with endocrine-responsive early breast cancer: update of study BIG 1-98. J Clin Oncol 2007;25:486-492.
36) Coughlin SS, Uhler RJ, Hall HI, Briss PA. Nonadherence to breast and cervical cancer screening: What are the linkages to chronic disease risk? Prev Chronic Dis 2004;1:A04.
37) Cummings DM, Whetstone 1, ShendeA, et al. Predictors of screening mammography: implications for office practice. Arch Fam Med 2000;9:870-875.
38) De Laurentiis M, Cancello G, D'Agostino D et al. Taxane-based combinations as adjuvant chemotherapy of early breast cancer: a meta-analysis of randomized trials. J Clin Oncol 2008;26:44-53.
39) DeSantis C, Howlader N, Cronin KA, Jemal A. Breast cancer incidence rates in US women are no longer declining. Cancer Epidemiolog Biomarkers Prev 2011;20:733-739.
40) Early Breast Cancer Trialists' Collaborative Group (EBCTCG). Effects of chemotherapy and hormonal therapy for early breast cancer on recurrence and 15-year survival: an overview of the randomised trials. Lancet 2005;365:1687-1717.
41) Engelman KK, Hawley DB, Gazaway R, Mosier MC, Ahluwalia JS, Ellerbeck EF. Impact of geographic barriers on the utilization of mammograms by older rural women. J Am Geriatr Soc 2002;50:62-68.
42) Fabian CJ. The what, why and how of aromatase inhibitors: hormonal agents for treatment and prevention of breast cancer. Int J Clin Pract 2007;61:2051-2063.
43) Feuer EJ, Wun LM. How much of the recent rise in breast cancer incidence can be explained by increases in mammography utilization? A dynamic population model approach. Am J Epidemiol1992;136:1423-1436.
44) Fireman BH, Quesenberry CP, Somkin CP, et al. Cost of care for cancer in a health maintenance organization. Health Care Financ Rev 1997;18:51-76.
45) Fisher B, Wolmark N, Redmond C, Deutsch M, Fisher ER. Findings from NSABP protocol no. b04: Comparison of radical mastectomy with alternative treatments. II. The clinical and biologic significance of medial- central breast cancers. Cancer 2006;48:1863-1872.
46) Fisher B, Anderson S, Bryant J, Margolese RG, Deutsch M, Fisher ER, Wolmark N. Twenty-year follow-up of a randomized trial comparing total mastectomy, lumpectomy, and lumpectomy plus irradiation for the treatment of invasive breast cancer. NEJM 2002;347:1233-1241.
47) Fleming ID, Cooper JS, Henson DE, et al. AJCC cancer staging manual, 5th edition. Philadelphia: Lippincott-Raven, 1997.
48) Foley KL, Kimmick G, Camacho F, Levine EA, Balkrishnan R, Anderson R. Survival disadvantage among Medicaid-insured breast cancer patients treated with breast conserving surgery without radiation therapy. Breast Cancer Res Treat 2007; 101:207-214.

49) Freedman GM, Anderson PR, Goldstein LJ et al. Routine mammography is associated with earlier stage disease and greater eligibility for breast conservation in breast carcinoma patients age 40 years and older. Cancer 2003;98:918-925.
50) Freedman RA, Virgo KS, He Y, Pavluck AL, Winer EP, Ward EM, Keating NL. The association of race/ethnicity, insurance status, and socioeconomic factors with breast cancer care. Cancer 2011;117:180-189.
51) Fu Az, Jhaveri M. Healthcare cost attributable to recently-diagnosed breast cancer in a privately-insured population in the United States. J Med Econ 2012;15:688-694.
52) Gail MH, Brinton LA, Byar DP, et al. Projecting individualized probabilities of developing breast cancer for white females who are being examined annually. J Natl Cancer Inst 1989;81:1879-1886.
53) Gierisch JM, O'Neill SC, Rimer BK, DeFrank JT, Bowling JM, Skinner CS. Factors associated with annual-interval mammography for women in their 40s. Cancer Epidemiol 2009;33:72-78.
54) Gierisch JM EJ, Brewer NT, Rimer BK,. Longitudinal predictors of nonadherence to maintenance of mammography. Cancer Epidemiol Biomarkers Prev 2010;19:1103-1111.
55) Glanz K, Resch N, Blake A, Gorchov P, Rimer B. Factors associated with adherence to breast cancer screening among working women. J Occup Med 1992;34:1071-1078.
56) Glass AG, Hoover RN. Changing incidence of breast cancer. J Natl Cancer Inst1988;80:1076-1077.
57) Glass AG, Lacey Jr. JV, Carreon JD, Hoover RN. Breast cancer incidence, 1980–2006: combined roles of menopausal hormone therapy, screening mammography, and estrogen receptor status. J Natl Cancer Inst 2007;99:1152-1161.
58) Goldhirsch A, Wood WC, Gelber RD, Coates AS, Thürlimann B, Senn HJ. 10th St. Gallen conference. Progress and promise: highlights of the international expert consensus on the primary therapy of early breast cancer 2007. Ann Oncol 2007;18:1133-1144.
59) Goodwin JS, Zhang DD, Ostir GV. Effect of depression on diagnosis, treatment, and survival of older women with breast cancer. J Am Geriatr Soc 2003;52:106-111.
60) Goss PE, Ingle JN, Martino S et al. A randomized trial of letrozole in postmenopausal women after five years of tamoxifen therapy for early-stage breast cancer. N Engl J Med 2003;349:1793-1802.
61) Greenall MJ, Wood WC. Cancer of the breast. In: Oxford textbook of surgery, 2nd edition. Morris PJ, Wood WC, eds. UK: Oxford University Press, 2000.
62) Grilli R, Scorpiglione N, Nicolucci A, Mainini F, Penna A, Mari E, Liberati A. Variation in use of breast surgery and characteristics of hospitals' surgical staff. Int J Qual Health Care 1994;6:233-238.
63) Goy JCM, Dobbs HJ, Henderson S et al. Variation in referral pattern for postoperative radiotherapy of patients with screen-detected breast cancer in the South Thames (East) region. Clin Oncol 1998;10:24-29.
64) Guadagnoli E, Weeks JC, Shapiro CL, Gurwitz JH, Borbas C, Soumerai SB. Use of breast-conserving surgery for treatment of stage I and stage II breast cancer. J Clin Oncol 1998;16:101-106.
65) Haggstrom DA, Quale C, Smith, Bindman R. Differences in the quality of breast cancer care among vulnerable populations. Cancer 2005;104:2347-2358.

66) Halabi S, Skinner CS, Samsa GP, Strigo TS, Crawford YS, Rimer BK. Factors associated with repeat mammography screening. J Fam Pract 2000;49:1104-1112.
67) Hebert-Croteau N. Brisson J. Latreille J. Rivard M. Abdelaziz N. Martin G. Compliance with consensus recommendations for systemic therapy is associated with improved survival of women with node-negative breast cancer. J Clin Oncol. 2004;22:3685–3693.
68) Hellquist BN, Duffy SW, Abdsaleh S, et al. Effectiveness of population- based service screening with mammography for women ages 40 to 49 years. Cancer 2011;117:714-722.
69) Hendrick RE, Helvie MA. United States Preventive Services Task Force screening mammography recommendations: Science ignored. AJR Am J Roentgenol 2011;196:W112-W116.
70) Humphrey LL, Helfand M, Chan BK, et al. Breast cancer screening: A summary of the evidence for the U.S. Preventive Services Task Force. Ann Intern Med 2002;137:347-360.
71) Ingram DM, McEvoy SP, Byrne MJ et al. Surgical caseload and outcomes for women with invasive breast cancer treated in Western Australia. The Breast 2005;14:11-17.
72) Iyengar R, Lund MJ, Lamson P, et al. Using National Quality Forum breast cancer indicators to measure quality of care for patients in an AVON comprehensive breast center. Breast J 2010;16:240-244.
73) Jagsi R, Abrahamse P, Morrow M, Hawley ST, Griggs JJ, Graff JJ, Katz SJ. Patterns and correlates of adjuvant radiotherapy receipt after lumpectomy and after mastectomy for breast cancer. J Clin Oncol 2010:28:2396-2403.
74) Jemal A, Ward E, Thun MJ. Recent trends in breast cancer incidence rates by age and tumor characteristics among U.S. women. Breast Cancer Res 2007;9:R28.
75) Kendrick T. Cardiovascular and respiratory risk factors and symptoms among general practice patients with long-term mental illness. Br J Psychiatry 1996;169:733-739.
76) Khanna R, Madhavan SS, Bhanegaonkar A, Remick SC. Prevalence, healthcare utilization, and costs of breast cancer in a state Medicaid fee-for-service program. J Womens Health 2011;20:739-747.
77) Kim J, Jang SN. Socioeconomic disparities in breast cancer screening among US women: trends from 2000 to 2005. J Prev Med Public Health 2008:41;186-194.
78) Kopans DB. The 2009 US Preventive Services Task Force (USPSTF) guidelines are not supported by science: the scientific support for mammography screening. Radiol Clin North Am 2010;48:843-857.
79) Laliberte L, Fennell ML, Papandonatos G. The relationship of membership in research networks to compliance with treatment guidelines for early-stage breast cancer. Med Care 2005;43:471.
80) Lambe M, Hsieh C, Tsaih S, Ekbom A, Adami HO, Trichopoulos D. Maternal risk of breast cancer following multiple births: a nationwide study in Sweden. Cancer Causes Control 1996;7:533-538.
81) Lamerato L, Havstad S, Gandhi S, et al. Economic burden associated with breast cancer recurrence: findings from a retrospective analysis of health system data. Cancer 2006;106:1875-1882.
82) Landercasper , Dietrich LL, Johnson M. A breast cancer review of compliance with National Comprehensive Cancer Network Breast Cancer guidelines. Am J Surg 2006;192:525-527.

83) Lawrence D, Kisely S. Review: Inequalities in healthcare provision for people with severe mental illness. J Psychopharmacol 2010;24:61-68.
84) Lawrence WF, Liang W, Mandelblatt JS, et al. Serendipity in diagnostic imaging: magnetic resonance imaging of the breast. J Nat Cancer Inst 1998;90:1792-1800.
85) Lee CH, Dershaw DD, Kopans D et al. Breast cancer screening with imaging: Recommendations from the society of breast imaging and the ACR on the use of mammography, breast MRI, breast ultrasound, and other technologies for the detection of clinically occult breast cancer. J Am Coll Radiol 2010;7:18-27.
86) Lee J, Vogel V. Who Uses Screening Mammography Regularly? Cancer Epidemiol Biomarkers Prev 1995;4:901-906.
87) Lerman C, Rimer B, Trock B, Balshem A, Engstrom P. Factors associated with repeat adherence to breast cancer screening. Prev Med 1990;19:279-290.
88) Li CI, Uribe DJ, Daling JR. Clinical characteristics of different histologic types of breast cancer. Br J Cancer 2005;93:1046-1052.
89) Litaker D, Tomolo A. Association of contextual factors and breast cancer screening: Finding new targets to promote early detection. J Womens Health 2007;16:36-45.
90) Mariotto AB, Yabroff KR, Shao Y, Feuer EJ, Brown ML. Projections of the cost of cancer care in the United States: 2010–2020. J Natl Cancer Inst 2011;103:117-128.
91) Maskarinec G, Pagano I, Lurie G, Bantum E, Gotay CC, Issell BF. Factors affecting survival among women with breast cancer in Hawaii. J Women's Health 2011;20:231-237.
92) Maughan KL, Lutterbie MA, Ham PS. Treatment of breast cancer. Am Fam Physician 2010,81:1339-1346.
93) Maxwell AB, Bradford RC. Predictors of interval mammography screening: results of a longitudinal study. J Womens Health 1996;5:343-349.
94) McGinty EE, Zhang Y, Guallar E, Ford DE, Steinwachs D, Dixon LB, Daumit GL. Cancer Incidence in a Sample of Maryland Residents With Serious Mental Illness. Psychiatr Serv 2012;63:714-717.
95) Miller A, Champion V. Mammography in older women: one- time and three- year adherence to guidelines. Nurs res 1996;45:39-45.
96) Mitchell AJ, Malone D, Doebbeling CC. Quality of medical care for people with and without comorbid mental illness and substance misuse: systematic review of comparative studies. Br J Psychiatry 2009;194:491-499.
97) Moss SM, Cuckle H, Evans A, Johns L, Waller M, Bobrow L. Effect of mammographic screening from age 40 years on breast cancer mortality at 10 years' follow-up: a randomised controlled trial. Lancet 2006;368:2053-2060.
98) National Cancer Institute. Breast cancer treatment. Available at http://www.cancer.gov/cancertopics/pdq/treatment/breast/Patient/page5. Accessed July 20, 2012.
99) National Cancer Institute. Stages of breast cancer. Available at http://www.cancer.gov/cancertopics/pdq/treatment/breast/Patient/page2#Keypoint12. Accessed November 19, 2012.
100) National Comprehensive Cancer Network. Breast cancer: treatment guidelines for patients. Available at http://screening.iarc.fr/doc/Breast_VIII.pdf. Accessed January 21, 2013.

101) Neuner JM, Gilligan MA, Sparapani R et al. Decentralization of breast cancer surgery in the United States. Cancer 2004;101:1323-1329.
102) Oestreicher N, Lehman CD, Seger DJ, Buist DS, White E. The incremental contribution of clinical breast examination to invasive cancer detection in a mammography screening program. Am J Roentgenol 2005;184:428-432.
103) Osborn DP. Topics in review: the poor physical health of people with mental illness. West J Med 2001;175:329.
104) Osteen, R. Breast Cancer. In: Lenhard RE, Osteen RT, Gansler R, eds. Clinical Oncology. Atlanta, GA: American Cancer Society; 2001:251–268.
105) Overgaard M, Hansen PS, Overgaard J, Rose C, Andersson M, Bach F, Zedeler K. Postoperative radiotherapy in high-risk premenopausal women with breast cancer who receive adjuvant chemotherapy. NEJM 1997;337:949-955.
106) Overgaard M, Jensen MB, Overgaard J, Hansen PS, Rose C, Andersson M, Mouridsen HT. Postoperative radiotherapy in high-risk postmenopausal breast-cancer patients given adjuvant tamoxifen: Danish Breast Cancer Cooperative Group DBCG 82c randomised trial. Lancet 1999;353:1641-1648.
107) Paskett ED, McLaughlin JL. Breast Cancer Screening. In: Holland JC, Breitbart WS, Jacobsen PB, et al., eds. Psycho-Oncology, 2nd edition. New York: Oxford University Press, 2011.
108) Phillips KA, Kerlikowske K, Baker LC, et al. Factors associated with women's adherence to mammography screening guidelines. Health Serv Res 1998;33:29-53.
109) Pilnik S, ed. Common Breast Lesions: A Photographic Guide to Diagnosis and Treatment. Cambridge University Press, 2003.
110) Ponhold L, Bickel H, Pinker K, Helbich TH. Mammography screening and follow-up of breast cancer. Hamdan Medical Journal 2012;5:5-18.
111) Rahman SM, Dignan MB, Shelton BJ. Factors influencing adherence to guidelines for screening mammography among women aged 40 years and older. Ethn Dis 2003;13:477-484.
112) Rakowski W. Meissner H. Vernon SW, et al. Correlates of repeat and recent mammography for women ages 45 to 75 in the 2002 to 2003 Health Information National Trends Survey (HINTS 2003)Cancer Epidemiol Biomarkers Prev 2006;15:2093.
113) Raucher GH, Tropman Hawley S, Earp JL. Baseline predictors of initiation vs. maintenance of regular mammography use among rural women. Prev Med 2005;40:822-830.
114) Ravdin PM, Cronin KA, Howlader N et al. The decrease in breast cancer incidence in 2003 in the United States. N Engl J Med 2007;356:1670-1674.
115) Roberts MM, Alexander FE, Anderson TJ, et al. Edinburgh trial of screening for breast cancer: mortality at seven years. Lancet 1990;335:241-246.
116) Romond EH, Perez EA, Bryant J et al. Trastuzumab plus adjuvant chemotherapy for operable HER2-positive breast cancer. N Engl J Med 2005;353:1673-1684.
117) Rosato R, Sacerdote C, Pagano E, Di Cuonzo D, Baldi I, Bordon R, Ciccone G. Appropriateness of early breast cancer management in relation to patient and hospital characteristics: a population based study in Northern Italy. Breast cancer res treat 2009;117:349-356.

118) Rosenberg L, Wise LA, Palmer JR, Horton NJ, Adams-Campbell LL. A multilevel study of socioeconomic predictors of regular mammography use among African-American women. Cancer Epidemiol Biomarkers Prev 2005;14:2628-2633.
119) Rim A, Chellman-Jeffers M. Trends in breast cancer screening and diagnosis. Cleve Clin J Med 2008;75:S2-S9.
120) Russo J, Russo IH. Hormonally induced differentiation: a novel approach to breast cancer prevention. Journal of Cellular Biochemistry1995;59:58-64.
121) Ryerson AB, Miller JW, Eheman CR, Leadbetter S, White MC. Recent trends in US mammography use from 2000–2006: a population-based analysis. Prev Med 2008;47:477-482.
122) Sabogal F, Merrill SS, Packel L. Mammography rescreening among older California women. Health Care Financ Rev 2001;22:63-75.
123) Sasser AC, Rousculp MD, Birnbaum HG, Oster EF, Lufkin E, Mallet D. Economic burden of osteoporosis, breast cancer, and cardiovascular disease among postmenopausal women in an employed population. Womens Health Issues 2005;15:97-108.
124) Satariano ER, Swanson GM, Moll PP. Nonclinical factors associated with surgery received for treatment of early-stage breast cancer. Am J Public Health 1992;82:195-198.
125) Shi L, Lebrun LA, Zhu J, Tsai J. Cancer screening among racial/ethnic and insurance groups in the United States: a comparison of disparities in 2000 and 2008. J Health Care Poor Underserved 2011;22:945-961.
126) Shirvani SM, Pan IW, Buchholz TA, Shih YCT, Hoffman KE, Giordano SH, Smith BD. Impact of evidence- based clinical guidelines on the adoption of postmastectomy radiation in older women. Cancer 2011;117:4595-4605.
127) Siegel R, DeSantis C, Virgo K, Stein K, Mariotto A, Smith T, Ward E. Cancer treatment and survivorship statistics, 2012. CA Cancer J Clin 2012;62:220-241.
128) Slomiany BA, McMasters KM, Chagpar AB. The recent decline in mammography rates is limited to low- to average-risk women. Am J Surg 2008;196:821-826.
129) Smith-Warner SA, Spiegelman D, Yaun SS, et al. Alcohol and breast cancer in women: a pooled analysis of cohort studies. JAMA 1998;279:535-540.
130) Smith I, Procter M, Gelber RD et al. HERA study team. 2-year follow-up of trastuzumab after adjuvant chemotherapy in HER2-positive breast cancer: a randomised controlled trial. Lancet 2007;369:29-36.
131) Smith GL, Shih YCT, Xu Y, Giordano SH, Smith BD, Perkins GH, Buchholz TA. Racial disparities in the use of radiotherapy after breast- conserving surgery: A national Medicare study. Cancer 2009;116:734-741.
132) Song L, Fletcher R. Breast cancer rescreening in low-income women. Am J Prev Med 1998;15:128-33.
133) Strzelczyk JJ, Dignan MB. Disparities in adherence to recommended followup on screening mammogram: interaction of sociodemographic factors. Ethn Dis 2002;12:77-86.
134) Tabar L, Fagerberg G, Duffy SW, et al. Update of the Swedish two-county program of mammographic screening for breast cancer. Radiol Clin North Am 1992;30:187-210.
135) Tabar L, Fagerberg G, Chen HH, et al. Efficacy of breast cancer screening by age: new results from the Swedish Two-county Trial. Cancer 1995;75:2507-2517.

136) Taylor, V. M., Taplin, S. H., Urban, N., White, E., and Peacock, S. Repeat mammography use among women ages 50–75. Cancer Epidemiol Biomark Prev 1995;4:409-413.
137) Teh W, Wilson AR. The role of ultrasound in breast cancer screening. A consensus statement by the European Group for Breast Cancer Screening. Eur J Cancer 1998; 34:449-450.
138) The American Congress of Obstetricians and Gynecologists. Annual mammograms now recommended for women beginning at age 40. Available at http://www.acog.org/About_ACOG/News_Room/News_Releases/2011/Annual_Mammograms_Now_Recommended_for_Women_Beginning_at_Age_40. Accessed July 22, 2012.
139) Thomas DB, Gao DL, Ray RM, et al. Randomized trial of breast self-examination in Shanghai: Final results. J Natl Cancer Inst 2002;94:1445-1457.
140) Treatment of Early-Stage Breast Cancer. NIH Consens Statement Online 1990;8:1-19
141) Vinitha Sree S, Ng EYK, Acharya RU, Faust O. Breast imaging: a survey. World J Clin Oncol 2011;2:171-178.
142) Voti L, Richardson LC, Reis I, Fleming LE, MacKinnon J, Coebergh JW. The effect of race/ethnicity and insurance in the administration of standard therapy for local breast cancer in Florida. Breast Cancer Res Treat 2006;95:89-95.
143) Vyas A, Madhavan S, Lemasters T, Atkins E, Gainor S, Kennedy S, et al. Factors influencing adherence to mammography screening guidelines in appalachian women participating in a mobile mammography program. J Community Health 2012;37:632-646.
144) Weir S, Posner HE, Jones WC, Willis G, Baxter JD, Clark RE. Disparities in routine breast cancer screening for Medicaid managed care members with a work-limiting disability. Medicare Medicaid Res Rev 2011;1.
145) Wolf AB, Brem RF. Decreased mammography utilization in the United States: why and how can we reverse the trend? Am J Roentgenol 2009;192:400-402.
146) Woloshin S, Schwartz LM. The benefits and harms of mammography screening: understanding the trade-offs. JAMA 2010;303:164-165.
147) Worthington J, Waterbor JW, Funkhouser E, Falkson C, Cofield S, Fouad M. Receipt of standard breast cancer treatment by African American and White women. Int J Med Sci 2008;5:181-188.
148) Wu H, Zhu K, Jatoi I, Shah M, Shriver CD, Potter J. Factors associated with the incompliance with mammogram screening among individuals with a family history of breast cancer or ovarian cancer. Breast Cancer Res Treat 2007;101:317-324.
149) Yood MU, McCarthy BD, Lee NC, Jacobsen G, Johnson CC. Patterns and characteristics of repeat mammography among women 50 years and older. Cancer Epidemiol Biomarkers Prev 1999;8:595-599.
150) Zhou J, Enewold L, Peoples GE, et al. Trends in cancer screening among Hispanic and White non-Hispanic women, 2000-2005. J Women's Health. 2010;19:2167-2174.

CHAPTER 2

HEALTHCARE BURDEN ASSOCIATED WITH BREAST CANCER IN THE MEDICAID PROGRAM

Introduction

Breast cancer is the second most frequently diagnosed cancer and the second leading cause of cancer-related death in women (American Cancer Society [ACS]). In 2013, an estimated 296,980 women were expected to be diagnosed with breast cancer and 39,620 women were estimated to die from breast cancer in the United States (US) (ACS). According to NIH estimates, one in eight women in the US will develop breast cancer in their lifetime (ACS). The common risk factors for breast cancer are early age at menarche, late age at menopause and first child birth, family history of breast cancer, benign breast disease, use of hormone replacement therapy, nulliparity, physical inactivity, poverty, inadequate education, alcohol intake, and lack of health insurance (Gail et al., 1989, Lambe et al., 1996, Burke et al., 1997, Collaborative Group on Hormonal Factors in Breast Cancer, 1997, Smith-Warner et al., 1998, Grenall and Wood, 2000, Chlebowski et al., 2003, Buchholz, 2009).

Breast cancer is primarily treated by surgical removal of the tumor. Surgical options for breast cancer include breast conserving surgery, radical mastectomy, modified radical mastectomy, and total mastectomy. Radiation therapy is generally used post surgery to reduce the likelihood of recurrence of breast cancer. Adjuvant systemic therapies such as chemotherapy, hormonal therapy, and tissue-targeted therapy have been associated with reduced

recurrence rates and improved breast cancer-specific survival and are an important part of the breast cancer treatment regimen (Maughan et al., 2010). The prevalence of breast cancer in the US has increased over the past few decades on account of increasing breast cancer survival rates due to improved treatment regimens and early detection of breast cancer owing to increased mammography screening rates (Alacacioglu et al., 2009, Breast cancer facts and figures 2011-2012). There were nearly 3 million breast cancer survivors in the US in 2012, and this number is expected to increase to 3.8 million by 2022 (Siegel et al., 2012).

An understanding of healthcare utilization and costs associated with breast cancer is crucial for effective breast cancer management. Information about the healthcare economic impact of breast cancer can help policy-makers in proper allocation of resources, thereby facilitating adequate treatment of the breast cancer patients. Such information can also make policy-makers aware about the burden of breast cancer and, in turn, potentially trigger healthcare interventions aimed at reducing the morbidity and mortality associated with breast cancer. Several studies in the past have estimated the monetary impact of breast cancer among various patient populations (Fireman et al., 1997, Brown et al., 2001, Sasser et al., 2005, Barron et al., 2008, Max et al., 2009, Khanna et al., 2011, Fu et al., 2012). Barron et al. (2008) estimated the economic burden of breast cancer in a managed care population in the US. The authors reported per member per month costs of breast cancer-related healthcare in the year 2004 to be $2,896 among beneficiaries with breast cancer, with hospitalization costs accounting to nearly 50% of the total costs. Surgery (62.3%) and pharmacotherapy (chemotherapy and hormonal therapy) (66.6%) were the most commonly received treatments. The average annual direct medical costs attributable to breast cancer were found to be $27,588. Similar to Barron et al. (2008), other studies have found significant healthcare costs associated with breast cancer (Fireman et al.,

1997, Brown et al., 2001, Sasser et al., 2005, Max et al., 2009, Khanna et al., 2011, Fu et al., 2012). However, to date, only one study has examined the healthcare burden of breast cancer in the Medicaid population (Khanna et al., 2011).

The Medicaid program is one of the largest health insurance programs in the US, providing coverage to nearly 60 million low-income and disabled individuals in the US (Kaiser Family Foundation [KFF]). Compared to other insured individuals, Medicaid beneficiaries are more likely to suffer from chronic diseases and have less favorable overall health (Cunningham et al., 2005, Holohan et al., 2003). On account of challenges such as inadequate social support, lower access to quality healthcare, illiteracy, poor nutrition, and problems with transportation and communication, the Medicaid population is inherently vulnerable to worse health outcomes (Landon and Epstein, 1999, Piecoro et al., 2001, Rowland, 2005). The prevalence of breast cancer has been found to be higher in the Medicaid population as compared to the general population (Mullins et al., 2004). It has also been reported that Medicaid recipients are more likely to have a higher breast cancer stage at diagnosis (Bradley et al., 2002).

Limited information currently exists regarding the healthcare burden associated with breast cancer in the Medicaid population. In one such study, Khanna et al. (2011) determined the healthcare burden of breast cancer in the West Virginia fee-for-service (FFS) Medicaid program using the 2005 data. The authors reported average annual costs of breast cancer-related healthcare per recipient to be $5,637 among beneficiaries with breast cancer. Hormone therapy (55.1%) was the most commonly received treatment. The average annual incremental costs associated with breast cancer were reported to be $3,408 per recipient. While the work conducted by Khanna et al. (2011) provides useful information about the healthcare burden of breast cancer in the Medicaid population, updated information in this regard, that is more

generalizable, is needed. In their study, Khanna et al. (2012) analyzed single-state Medicaid data. Further, the authors used only Medicaid FFS data and did not consider Medicaid managed care data in their study. Over the years, an increasing number of Medicaid enrollees has been shifted to Medicaid managed care. As of February 2010, over 70 percent of the Medicaid enrollees were receiving their healthcare services through managed care and this number is expected to increase further in the coming years (KFF). In order to obtain an exhaustive estimate of the healthcare burden of breast cancer in the Medicaid population, it is necessary to take into account the breast cancer-related healthcare utilization and costs in Medicaid managed care enrollees.

The objective of the current study was to determine the healthcare burden associated with breast cancer in the Medicaid population using multistate Medicaid medical and pharmacy administrative claims data. Breast cancer-related medical services and treatment (surgery, radiation, hormonal therapy, and chemotherapy) utilization among Medicaid enrollees with breast cancer was determined. In addition, the incremental healthcare use and costs associated with breast cancer were determined by comparing the all-cause healthcare use and costs of women with and without breast cancer.

Methods

Data source

The 2006-2008 Medicaid analytic extract (MAX) files for 39 states (all states except Alaska, Hawaii, Maine, Missouri, Montana, North Dakota, Pennsylvania, South Dakota, Utah, Wisconsin, Wyoming, and District of Columbia) were used for the purpose of the study. Medicaid Analytic Extract (MAX) files are a set of person-level files which are made available

by Centers for Medicare and Medicaid services (CMS) for the purpose of supporting research and policy analysis. Information about Medicaid enrollment, utilization, and expenditure is made available through MAX personal summary, inpatient services, other therapy, and prescription drug files. The MAX personal summary file contains demographic data such as date of birth, gender, race, and age, basis of eligibility, monthly enrollment status, period of managed care eligibility, and utilization summary. The MAX inpatient file contains details about inpatient services utilized by the Medicaid enrollees with important fields such as International Classification of Diseases, ninth revision, clinical modification (ICD-9-CM) diagnoses codes (up to ten diagnostic fields), ICD-9-CM, Current procedural terminology 4^{th} edition (CPT-4) or Healthcare Common Procedure Coding System (HCPCS) procedure codes (up to seven procedure fields), service beginning date, ending date of service, and payment amount. The MAX prescription drug file contains information about the prescriptions dispensed to recipients, including days of supply, quantity supplied, National Drug Classification (NDC) code, prescription date, and the amount paid. The MAX other therapy file contains information about all non-institutional Medicaid services provided to Medicaid enrollees, including physician services, lab/X-ray, and clinic services. Important fields in this file include ICD-9-CM diagnoses codes (up to two diagnostic fields), ICD-9-CM, CPT-4, or HCPCS procedure codes (one procedure field), provider identification number, service beginning date, ending date of service, place of service, charge amount, payment amount, and UB-92 revenue codes. In order to protect patient privacy, each of the files was made available to the researcher without identifying the individual recipients. All the files were linked using a unique encrypted recipient identification number. Approval for the conduct of the project was taken from Institutional review board (IRB)

at University of Mississippi, following which data use agreement (DUA) was executed with CMS through Research Data Assistance Center (ResDAC).

Study sample

The target population for this study consisted of women who were continuously enrolled in the Medicaid program during the years 2006-2008 and who were at least 18 years of age as of January 01, 2006 and less than 65 years of age as of December 31, 2008. Since the occurrence of breast cancer in males and adolescents is rare, the study included only women aged 18 years or more. In addition, the study excluded women aged 65 years or more since Medicare is the primary payer in these individuals, and the MAX files do not have complete information about their healthcare use. Women aged less than 65 years, who were enrolled in both Medicare and Medicaid, were also excluded from the study due to incomplete data in the MAX files. Women with at least one medical claim with a primary diagnosis of breast cancer (ICD-9-CM codes of 174 [Malignant neoplasm of the female breast], 233.0 [Carcinoma in situ of breast], 238.3 [Neoplasm of uncertain behavior of breast], and 239.3 [Neoplasm of unspecified nature of breast]) during the years 2007 or 2008 were classified as breast cancer cases (Barron et al., 2008). For the purpose of determining incremental healthcare use and costs associated with breast cancer, one control without a diagnosis of breast cancer during the study period was selected from the target population for each case by matching on age (± 5 years), race, state of residence, location of residence (metropolitan, suburban, or rural), and the type of reimbursement system (FFS only [recipients who were enrolled in FFS Medicaid during 2006-2008] and managed care [recipients who were enrolled in Medicaid managed care for at least one month during 2006-2008]). Cases without any corresponding control were excluded from the study.

Measures

Treatment use among breast cancer patients was reported as number and percentage of patients per year having at least one claim for surgery, radiotherapy, chemotherapy, hormonal therapy, and other drugs during the years 2007 and 2008. Breast cancer surgery was identified from the MAX inpatient and other therapy file records with CPT-4 codes of 19120-19126, 19160-19162, 19180, 19182, 19200, 19220, 19240, 19260, 19271, 19272, 19290-19298, 19316-19396, and 19499 and ICD-9-CM procedure codes of 8520-8525, 8534-8536, 8541-8548, and 8663. Radiation therapy was determined from the records within the MAX inpatient and other therapy file with CPT-4 codes of 77261-77418, 77427-77499, and 77520-77525, ICD-9-CM procedure codes of 9221-9226, and ICD-9-CM diagnosis codes of V580, V661, and V671. Chemotherapy was identified from the MAX inpatient and other therapy file records with HCPCS codes of J8520 and J8521 (capecitabine), J8530 (oral cyclophosphamide), J9070-J9097 (cyclophosphamide), J9190 (5-flurouracil), J9260 and J9250 (methotrexate), J9201 (gemcitabine), J9390 (vinorebine), J9265 (paclitaxel), J9170 (docetaxel), J9000 and J9001 (doxorubicin), J9178 (epirubicin), J9045 (carboplatin), J9060 and J9062 (cisplatin), and J9355 (trastuzumab), ICD-9-CM procedure code of 9225, and ICD-9-CM diagnosis codes of V581, V662, and V672. In addition, records within the MAX drug file with NDC codes for the chemotherapy drugs were used to identify chemotherapy use. Hormone therapy was identified using the MAX inpatient and other therapy file records with HCPCS codes of S0187 (tamoxifen), J9395 (fulvestrant), S0170 (anastrozole), and S0156 (exemestane) and from the MAX prescription drug file records with NDC codes for the drugs. Drugs goserelin (HCPCS

code of J9202) and megestrol (HCPCS code of S0179) were classified as other drugs since they do not belong to a particular category (Barron et al., 2008).

Breast cancer-related healthcare use among cases of breast cancer was determined in the form of number of breast cancer-related inpatient, outpatient, and emergency room (ER) visits. An inpatient visit was considered to be breast cancer-related if the primary diagnosis code associated with the record was for breast cancer (ICD-9-CM code of 174, 233.0, 238.3, or 239.3). Outpatient and ER visits were considered to be breast cancer-related if the primary and/or secondary diagnosis code associated with the records were for breast cancer. The 2007 and 2008 MAX inpatient and other therapy files were used for identifying breast cancer-related healthcare use. The MAX inpatient file is an event-level file and hence each observation was considered as one visit. Observations with place of service codes of 11 (office), 22 (outpatient hospital), 24 (ambulatory service center), 50 (federally qualified health center), 71 (state or local public health clinic), or 72 (rural health clinic) and type of service codes of 08 (physicians), 10 (other practitioners), 11 (outpatient hospital), 12 (clinic), 37 (nurse practitioner services) or those with procedure codes 99201-99215, 99241-99245, 99354-99355, 99381-99429 in the other therapy file were classified as outpatient visits. The MAX other therapy file is a claim-level file and hence we defined outpatient visits based on the date of service. If a recipient had one or more observations on a particular day that conformed to the above mentioned criteria, she was considered to have had an outpatient visit on that day. Observations with place of service code of 23 in the other therapy file and those with revenue code of 450-459 or procedure codes of 99281-99285 in the other therapy file or inpatient file were considered as ER visits. Mean number of breast cancer-related inpatient, outpatient, and ER visits per recipient per year were reported.

All results for breast cancer-related healthcare utilization were reported by age, race, and location of residence. Age was classified into five categories: 18-29 years, 30-39 years, 40-49 years, 50-59 years, and 60-64 years. Race was be categorized as white, black, Hispanic or Latino, Asian, Native Hawaiian or other Pacific islander, American Indian or Alaskan Native, and others (consisting of more than one race and unknown race). State of residence was classified into 39 categories. The location of residence consisted of categories of metropolitan, suburban, rural, and unknown and was defined for each recipient based on the United States Department of Agriculture (USDA) rural-urban continuum codes: metropolitan location (codes 0-3), suburban location (codes 4-5), and rural location (codes 6-9). The rural-urban continuum codes were determined based on the Federal Information Processing Standard (FIPS) code for the county of residence listed in the 2006 MAX personal summary file. The location of residence for recipients with a missing value for the FIPS code was classified as unknown.

Incremental economic burden associated with breast cancer in the Medicaid population was measured based on all-cause healthcare costs among Medicaid recipients with and without breast cancer. The data from the 2007 and 2008 MAX personal summary files were used for this purpose. Costs were considered from the perspective of Medicaid and hence only the amount reimbursed by Medicaid was used while determining the costs. Other payments such as copayments, deductibles, and third party payer amounts were not included in the cost calculation. While assessing healthcare costs, Charlson comorbidity index (CCI) was included as a measure of case mix differences between Medicaid enrollees with and without breast cancer. The D'Hoore adaptation of CCI was used in this study. CCI was calculated based on the medical records for the recipients during the year 2006. Breast cancer was excluded from the CCI calculation.

Statistical analysis

The mean number of breast cancer-related inpatient, outpatient, and ER visits per recipient per year was compared among different categories of age, race, and location of residence using Kruskal-Wallis one-way analysis of variance test (ANOVA). Post hoc comparisons were performed using a macro developed by Elliott and Hynan (2011). The mean number of all-cause inpatient, outpatient, and ER visits and the total all-cause healthcare costs per year were compared between Medicaid enrollees with and without breast cancer using the non-parametric Wilcoxon rank sum test. Multivariable comparison of all-cause costs between recipients with and without breast cancer was performed using a generalized linear model (GLM) with log link and Poisson distribution. The suitable distribution for the GLM was determined using Modified Park's test. CCI was used as the covariate in the GLM. Level of significance (α) of 0.05 was used in all the analyses. Means and standard deviations were reported for the continuous variables. Frequencies and percentages were reported for the categorical variables. The greedy algorithm was used for matching cases and controls. All analyses were performed using Statistical Analysis System (SAS) version 9.3 (SAS Institute Inc., Cary, NC). The SAS procedure PROC GENMOD was used for fitting the GLM.

Results

A total of 34,675 recipients with one or more medical claims with a primary diagnosis of breast cancer was identified during 2007-2008. Among these, 477 recipients did not have a corresponding matched control and hence were excluded from the study. Table 2.1 presents the demographic characteristics of the final study sample. Among the 34,198 cases included in the

study sample, nearly 32% belonged to the age group 40-49 years, whereas nearly 44% were aged 50-59 years. In terms of race, roughly 43% were whites, 22% were blacks, and the remaining 35% consisted of ethnic minorities such as Hispanics or Latinos, Asians, Native Hawaiians/ other Pacific islanders, and American Indians/ Alaskan natives. Majority of the study sample (82.26%) resided in metropolitan counties.

Table 2.1. Demographic characteristics of Medicaid enrollees with breast cancer

Characteristic	**N (%)**
Age (years)	
18-29	1,202(3.52)
30-39	3,464 (10.13)
40-49	10,862 (31.76)
50-59	15,114 (44.20)
60-64	3,556 (10.40)
Race	
White	14,658 (42.86)
Black	7,505 (21.95)
Hispanic or Latino	4,247 (12.42)
Asian	1,763 (5.16)
Native Hawaiian or other Pacific islander	593 (1.73)
American Indian or Alaskan native	307 (0.9)
Others	5,125 (14.99)
Location	
Metropolitan	28,132 (82.26)
Suburban	2,070 (6.05)
Rural	3,559 (10.41)
Unknown	437 (1.28)
Total	**34,198 (100)**

Table 2.2 presents the use of different types of breast cancer treatments among recipients with breast cancer in the years 2007 and 2008. Roughly 42% and 46% of the recipients had one or more claims for any breast cancer treatment in 2007 and 2008, respectively. Hormonal therapy was the most commonly used treatment (26.75% and 28.13% of the recipients in 2007

and 2008 respectively). Breast cancer surgery was the next most commonly used treatment (12.49% and 13.60% of the recipients in 2007 and 2008 respectively), followed by chemotherapy (8.25% and 9.70% of the recipients in 2007 and 2008 respectively) and radiation therapy (7.62% and 9.04% of the recipients in 2007 and 2008 respectively).

Table 2.2. Annual treatment utilization among Medicaid enrollees with breast cancer, 2007-2008.

	2007	2008
Treatment	**N (%)[a]**	**N (%)[a]**
Breast cancer surgery	4,273 (12.49)	4,652 (13.60)
Radiation therapy	2,643 (7.62)	3,092 (9.04)
Chemotherapy	2,822 (8.25)	3,316 (9.70)
Hormonal therapy	9,149 (26.75)	9,620 (28.13)
Other therapy	445 (1.30)	604 (1.77)

[a]Percentage is based on total number of recipients with breast cancer (34,198)

Table 2.3 describes the average annual breast cancer-related healthcare use among recipients with breast cancer during 2007-2008. With an average of 4.345 (±7.312) visits per recipient per year, outpatient visits accounted for over 95% of the breast cancer-related healthcare visits. Breast cancer-related outpatient visits were found to vary by age and race. In the post-hoc tests, it was found that recipients aged 18-29 years (2.472 visits per recipient per year) had lower use of breast cancer-related outpatient services as compared to those aged 30-39 (4.329 visits per recipient per year), 40-49 (4.606 visits per recipient per year), 50-59 (4.380 visits per recipient per year), and 60-64 years (4.074 visits per recipient per year) (Tables 2.3 and 2.3a). Breast cancer-related outpatient use was higher in Hispanics/ Latinos (4.824 visits per recipient per year) as compared to whites (4.164 visits per recipient per year) and in American Indians/Alaskan natives (5.952 visits per recipient per year) as compared to whites and blacks

(4.477 visits per recipient per year) (Tables 2.3 and 2.3b). The average breast cancer-related inpatient visits per patient per year were found to be 0.039 (±0.183). Breast cancer-related inpatient visits were found to vary across different categories of age and race. Breast cancer-related inpatient use was higher in recipients aged 30-39 years (0.052 visits per recipient per year) as compared to those aged 18-29 years (0.030 visits per recipient per year) and 50-59 and 60-64 years (0.036 visits per recipient per year) (Tables 2.3 and 2.3c). American Indians/Alaskan natives had the highest number of breast cancer-related inpatient visits per recipient per year (0.070) among all the races (Tables 2.3 and 2.3d). The average breast cancer-related ER visits per recipient per year were found to be 0.086 (±0.636). The use of breast cancer-related ER services was higher in recipients aged 30-39 (0.104 visits per recipient per year) and 40-49 years (0.098 visits per recipient per year) as compared to those aged 18-29 years (0.052 visits per recipient per year), 50-59 years (0.073 visits per recipient per year), and 60-64 years (0.091 visits per recipient per year) (Tables 2.3 and 2.3e). American Indians/Alaskan natives had the highest number of breast cancer-related ER visits (0.345 visits per recipient per year) among all the races. Blacks had higher use of breast cancer-related ER services (0.097 visits per recipient per year) as compared to whites (0.085 visits per recipient per year) (Tables 2.3 and 2.3f). In terms of location, recipients with unknown location had lesser number of breast cancer-related ER visits (0.014 visits per recipient per year) as compared to those residing in metropolitan (0.088 visits per recipient per year), suburban (0.075 visits per recipient per year), and rural (0.075 visits per recipient per year) locations (Tables 2.3 and 2.3g).

Table 2.3. Average annual breast cancer-related healthcare utilization among Medicaid enrollees, 2007-2008

Demographic characteristic	Inpatient visits	p	Outpatient visits	p	Emergency room visits	p
Age (years)		< 0.0001		< 0.0001		< 0.0001
18-29	0.030		2.472		0.052	
30-39	0.052		4.329		0.104	
40-49	0.044		4.606		0.098	
50-59	0.036		4.380		0.073	
60-64	0.036		4.074		0.091	
Race		< 0.0001		< 0.0001		< 0.0001
White	0.031		4.164		0.085	
Black	0.049		4.477		0.097	
Hispanic or Latino	0.032		4.824		0.097	
Asian	0.051		3.995		0.062	
Native Hawaiian or other Pacific islander	0.028		4.642		0.062	
American Indian or Alaskan native	0.070		5.952		0.345	
Others	0.050		4.280		0.054	
Location		0.654		0.306		0.0003
Metropolitan	0.042		4.367		0.088	
Suburban	0.031		4.309		0.075	
Rural	0.031		4.261		0.075	
Unknown	0.028		3.977		0.014	
Total	0.039		4.345		0.086	

Table 2.3a. Results for the post hoc tests with outpatient visits as the dependent variable and age as the independent variable

	18-29	30-39	40-49	50-59	60-64
18-29	-				
30-39	sig	-			
40-49	sig	sig	-		
50-59	sig	sig	ns	-	
60-64	sig	sig	ns	ns	-

sig: significant, ns: non-significant

Table 2.3b. Results for the post hoc tests with outpatient visits as the dependent variable and race as the independent variable

	White	Black	Hispanic or Latino	Asian	Native Hawaiian or other Pacific islander	American Indian or Alaskan native	Others
White	-						
Black	ns	-					
Hispanic or Latino	sig	ns	-				
Asian	ns	ns	ns	-			
Native Hawaiian or other Pacific islander	ns	ns	ns	ns	-		
American Indian or Alaskan native	sig	sig	ns	ns	ns	-	
Others	ns	ns	ns	ns	ns	sig	-

sig: significant, ns: non-significant

Table 2.3c. Results for the post hoc tests with inpatient visits as the dependent variable and age as the independent variable

	18-29	30-39	40-49	50-59	60-64
18-29	-				

30-39	sig	-			
40-49	ns	ns	-		
50-59	ns	sig	ns	-	
60-64	ns	sig	ns	ns	-

sig: significant, ns: non-significant

Table 2.3d. Results for the post hoc tests with inpatient visits as the dependent variable and race as the independent variable

	White	Black	Hispanic or Latino	Asian	Native Hawaiian or other Pacific islander	American Indian or Alaskan native	Others
White	-						
Black	ns	-					
Hispanic or Latino	ns	ns	-				
Asian	ns	ns	ns	-			
Native Hawaiian or other Pacific islander	ns	ns	ns	ns	-		
American Indian or Alaskan native	sig	ns	sig	sig	sig	-	
Others	ns	ns	ns	ns	ns	sig	-

sig: significant, ns: non-significant

Table 2.3e. Results for the post hoc tests with emergency room visits as the dependent variable and age as the independent variable

	18-29	30-39	40-49	50-59	60-64
18-29	-				
30-39	sig	-			
40-49	sig	ns	-		
50-59	ns	sig	sig	-	

60-64	ns	sig	sig	ns	-

sig: significant, ns: non-significant

Table 2.3f. Results for the post hoc tests with emergency room visits as the dependent variable and race as the independent variable

	White	Black	Hispanic or Latino	Asian	Native Hawaiian or other Pacific islander	American Indian or Alaskan native	Others
White	-						
Black	sig	-					
Hispanic or Latino	ns	ns	-				
Asian	sig	sig	sig	-			
Native Hawaiian or other Pacific islander	ns	sig	ns	ns	-		
American Indian or Alaskan native	sig	sig	sig	sig	sig	-	
Others	sig	sig	sig	ns	ns	sig	-

sig: significant, ns: non-significant

Table 2.3g. Results for the post hoc tests with emergency room visits as the dependent variable and location as the independent variable

	Metropolitan	Suburban	Rural	Unknown
Metropolitan	-			
Suburban	ns	-		
Rural	ns	ns	-	
Unknown	sig	sig	sig	-

sig: significant, ns: non-significant

Table 2.4 depicts the average annual all-cause healthcare use and costs incurred during 2007-2008 among recipients with breast cancer and the matched controlled group of enrollees without breast cancer. Women with breast cancer had significantly higher number of inpatient (0.38±0.97 vs. 0.27±0.81, $p < 0.0001$), outpatient (17.21±14.90 vs. 11.14±14.09, $p < 0.0001$), and ER visits (1.35±3.03 vs. 1.22±3.00, $p < 0.0001$) per recipient per year as compared to women without breast cancer. The total all-cause healthcare costs per recipient per year were also higher among women with breast cancer ($14,954.83±20,802.83) as compared to those without breast cancer ($11,330.89±17,613.13, $p < 0.0001$). The results of the generalized linear model (GLM) fitted for multivariable comparison of all-cause healthcare costs between recipients with and without breast cancer are presented in Table 2.5. Recipients with breast cancer had nearly 23.4% higher costs per recipient per year as compared to those without breast cancer (estimate = 0.2014, 95% confidence interval = 0.1955 – 0.2252, $p < 0.0001$). Based on the results of the GLM, the predicted per recipient per year costs were found to be $15,894.94±11,073.78 in recipients with breast cancer and $11,007.56±4,996.16 in recipients without breast cancer.

Table 2.4. Average annual all-cause healthcare utilization and costs among Medicaid enrollees with and without breast cancer, 2007-2008

Variable	Enrollees with breast cancer (N = 34,198)	Enrollees without breast cancer (N = 34,198)	p
Inpatient visits per year, Mean(SD)	0.38(0.97)	0.27(0.81)	<0.0001
Outpatient visits per year, Mean(SD)	17.21(14.90)	11.14(14.09)	<0.0001
Emergency room visits per year, Mean(SD)	1.35(3.03)	1.22(3.00)	<0.0001
Total costs per year ($), Mean(SD)	14,954.83(20,802.83)	11,330.89(17,613.13)	<0.0001

SD: standard deviation

Table 2.5. Generalized linear model for comparison of all-cause healthcare costs between Medicaid enrollees with and without breast cancer, 2007-2008

	Estimate	95% confidence interval	p
Intercept	9.0635	9.0520 – 9.0751	< 0.0001
Case	0.2104	0.1955 – 0.2252	< 0.0001
Control	0		
Charlson comorbidity index	0.1827	0.1786 – 0.1868	< 0.0001

Discussion

This study determined the healthcare burden of breast cancer in the economically underprivileged Medicaid population using recent multistate Medicaid data. To the best of our knowledge, the current study is the first to provide estimates of breast cancer burden in the national Medicaid population. Proportions of breast cancer patients receiving different breast cancer treatments (surgery, radiation therapy, chemotherapy, hormonal therapy, and other therapies) were reported. Breast cancer-related healthcare use in the form of inpatient, outpatient, and ER visits was determined in recipients with breast cancer. The incremental healthcare burden attributable to breast cancer was determined by comparing the all-cause healthcare use and costs between Medicaid recipients with breast cancer and a matched control group of recipients without breast cancer.

Hormonal therapy was the most commonly used treatment in 2007 (~27% of the recipients receiving treatment) and 2008 (~28% of the recipients receiving treatment) among recipients with breast cancer. Adjuvant therapies including hormonal therapy, chemotherapy, and radiation therapy accounted for ~75% of the treatment use whereas surgical treatments were

responsible for ~22% of the treatment use in 2007 and 2008. As mentioned previously, breast cancer treatment generally consists of surgical removal of the tumor followed by adjuvant therapies to prevent breast cancer recurrence. Thus the results obtained in this study indicate that considerable proportion of the women in our study sample included women who were diagnosed with breast cancer and received their primary surgical treatment during years prior to the study period.

Outpatient visits accounted for more than 95% of the breast cancer-related healthcare visits among recipients with breast cancer. This finding could be attributed to the fact that most of the breast cancer treatments including surgical treatments and adjuvant therapies are administered in outpatient settings in the recent times due to technological advances in breast cancer treatment. Inpatient facilities are used in only a few patients undergoing mastectomies and axillary lymph node dissections (Russo et al., 2006). Regarding the breast cancer-related healthcare use in different age groups, greatest per recipient per year breast cancer-related outpatient visits were observed in the age group 40-49 years whereas lowest per recipient per year breast cancer-related outpatient visits were observed in the age group 18-29 years. The age group 30-39 years was found to have highest per recipient breast cancer-related inpatient and ER visits, whereas the age group 50-59 years had lowest per recipient per year breast cancer-related inpatient and ER visits. Ethnic minorities were found to have greater number of per recipient per year breast cancer-related inpatient, outpatient, and ER visits as compared to whites for the most part. These results provide a cross-sectional snapshot of the breast cancer-related healthcare use in different demographic categories during 2007-2008, which could be useful from the point of view of resource allocation for the Medicaid policy makers. However, direct comparison of the healthcare use across these demographic categories was not possible due to lack of information

about time since diagnosis of breast cancer and stage of breast cancer in the MAX files. It is possible that recipients belonging to demographic categories with higher breast cancer-related healthcare use were more recently diagnosed with breast cancer or had higher stage of breast cancer as compared to those belonging to categories with lower healthcare use. Details about clinical characteristics of the cancer and date of diagnosis are available in cancer registries. Future studies could use cancer registry-linked administrative claims data to study the impact of various demographic and clinical factors on breast cancer-related healthcare use in the Medicaid population.

Recipients with breast cancer were found to have significantly higher average annual all-cause inpatient, outpatient, and ER visits as compared to those without breast cancer. These results are indicative of the considerable healthcare utilization associated with breast cancer in the Medicaid population. Our findings are somewhat consistent to those of Khanna et al. (2011), who also reported incremental healthcare use associated with breast cancer in the West Virginia Medicaid FFS population. In that study, women with breast cancer had significantly greater average all-cause physician office visits as compared to those without breast cancer.

In addition to average annual healthcare visits, recipients with breast cancer were also found to have higher average annual all-cause costs ($14,954.83) as compared to those without breast cancer ($11,330.89). In the multivariable analyses that controlled for CCI, recipients with breast cancer were found to have ~23.4% higher per recipient per year costs as compared to those without breast cancer. The predicted per recipient per year costs in the adjusted model were found to be $15,894.94(±11,073.78) in recipients with breast cancer and $11,007.56(±4,996.16) in recipients without breast cancer, resulting in an incremental difference of $4,887.38. Our finding of $14,955 average per recipient per year all-cause costs among

recipients with breast cancer is similar to that of Khanna et al. (2011), who found average costs of $16,435 among FFS Medicaid recipients in West Virginia. The slightly lower cost estimates in our study could be because we included recipients enrolled in both Medicaid managed care and FFS, whereas the Khanna et al. (2012) study only included FFS recipients. One of the major reasons for the increasing movement towards Medicaid managed care is the cost savings associated with the managed care environment as compared to traditional FFS system.

Some limitations in the study need to be addressed. Coding errors might have occurred during claims processing which might have impacted the study results. Individuals eligible for both Medicare and Medicaid (dual eligibles) were excluded from the study on account of incomplete data and hence the results obtained from the study may not be representative of the entire Medicaid population. The encounter data for the managed care enrollees submitted by the states do not undergo quality checks and hence can contribute to the inaccuracy in the results. Healthcare utilization and costs generally vary by the stage of cancer and treatment phrase. However these factors were not taken into account in the current study due to lack of information in the MAX files. The current study did not consider the possible relocation of recipients between states and counties during the study period. The study results must be interpreted in light of these limitations.

This study provided important insights concerning the healthcare utilization and costs associated with breast cancer in the Medicaid population. Outpatient visits accounted for the majority of the breast cancer-related healthcare utilization among recipients with breast cancer. Breast cancer-related healthcare utilization was higher among middle-aged women and ethnic minorities as compared to adolescent and elderly women and whites respectively. Considerable healthcare burden of breast cancer was observed in the Medicaid population with average annual

all-cause healthcare utilization and costs being significantly higher among recipients with breast cancer as compared to a matched control group of recipients without breast cancer. Policy makers could use the findings from this study for efficient resource allocation and planning strategies aimed at reducing disparities in the treatment of breast cancer patients enrolled in Medicaid.

LIST OF REFERENCES

1) Alacacioglu A, Yavuzsen T, Dirioz M, Yilmaz U. Quality of life, anxiety and depression in Turkish breast cancer patients and in their husbands. Med Oncol 2009;26:415-419.
2) American Cancer Society. What are the key statistics about breast cancer? Available at http://www.cancer.org/Cancer/BreastCancer/DetailedGuide/breast-cancer-key-statistics. Accessed July 17, 2012.
3) American Cancer Society. Breast cancer facts and figures 2013-2014. Available at: http://www.cancer.org/acs/groups/content/@research/documents/document/acspc-040951.pdf. Accessed January 13, 2014.
4) Barron JJ, Quimbo R, Nikam PT, Amonkar MM. Assessing the economic burden of breast cancer in a U.S. managed care population. Breast Cancer Res Treat 2008;109:367-377.
5) Bradley CJ, Given CW, Roberts C. Race, socioeconomic status, and breast cancer treatment and survival. J Natl Cancer Inst 2002;94:490-496.
6) Brown ML, Yabroff KR. Economic impact of cancer in the United States. In: David Schottenfeld , Joseph F. Faumeni J, eds. Cancer epidemiology and prevention. New York: Oxford University Press, 2004.
7) Buchholz TA. Radiation therapy for early-stage breast cancer after breast-conserving surgery. N Engl J Med 2009;360:63-70.
8) Burke W, Daly M, Garber J, et al. Recommendations for follow-up care of individuals with an inherited predisposition to cancer. II. BRCA1 and BRCA2. JAMA 1997;277:997-1003.
9) Centers for Medicare and Medicaid Services. Medicaid data sources – general information. Available at http://www.cms.gov/Research-Statistics-Data-and-Systems/Computer-Data-and-Systems/MedicaidDataSourcesGenInfo/index.html?redirect=/MedicaidDataSourcesGenInfo/MSIS/list.asp. Accessed July 25, 2012.
10) Centers for Medicare and Medicaid Services. Medicaid analytic extract (MAX) general information. Available at http://www.cms.gov/Research-Statistics-Data-and-Systems/Computer-Data-and-Systems/MedicaidDataSourcesGenInfo/MAXGeneralInformation.html. Accessed July 25, 2012.
11) Chlebowski RT, Hendrix SL, Langer RD, et al. Influence of estrogen plus progestin on breast cancer and mammography in healthy postmenopausal women: the Women's Health Initiative Randomized Trial. JAMA 2003;289:3243-3253.
12) Collaborative Group on Hormonal Factors in Breast Cancer. Breast cancer and hormone replacement therapy: collaborative reanalysis of data from 51 epidemiological studies of 52,705 women with breast cancer and 108,411 women without breast cancer. Lancet 1997;350:1047-1059.
13) Cunningham PJ. Medicaid Cost Containment and Access to Prescription Drugs. Health Affairs (Millwood) 2005;24:780-789.
14) D'Hoore W, Bouckaert A, Tilquin C. Practical considerations on the use of the Charlson comorbidity index with administrative data bases. J Clin Epidemiol 1996;49:1429-1433.
15) Fireman BH, Quesenberry CP, Somkin CP, et al. Cost of care for cancer in a health maintenance organization. Health Care Financ Rev 1997;18:51-76.
16) Fu Az, Jhaveri M. Healthcare cost attributable to recently-diagnosed breast cancer in a privately-insured population in the United States. J Med Econ 2012;15:688-694.

17) Gail MH, Brinton LA, Byar DP, et al. Projecting individualized probabilities of developing breast cancer for white females who are being examined annually. J Natl Cancer Inst 1989;81:1879-1886.
18) Greenall MJ, Wood WC. Cancer of the breast. In: Oxford textbook of surgery, 2nd edition. Morris PJ, Wood WC, eds. UK: Oxford University Press, 2000.
19) Holohan J, Weil A, Wiener J, eds. Federalism and health policy. Washington, DC: Urban Institute Press, 2003.
20) Kaiser Family Foundation. Medicaid as a platform for broader health reform: supporting high-need and low-income populations. Available at http://www.kff.org/medicaid/upload/7898.pdf. Accessed July 20, 2012.
21) Kaiser Family Foundation. Medicaid Coverage and Spending in Health Reform: National and state-by-state results for adults at or below 133% FPL. Available at http://www.kff.org/healthreform/upload/medicaid-coverage-and-spending-in-health-reform-national-and-state-by-state-results-for-adults-at-or-below-133-fpl.pdf. Accessed July 18, 2012.
22) Kaiser Family Foundation. Financing the Medicaid Program: The Many Roles of Federal and State Matching Funds. Available at http://www.kff.org/Medicaid/upload/Financing-the-Medicaid-Program-the-Many-Roles-of-Federal-and-State-Matching-Funds-Policy-Brief.pdf. Accessed July 20, 2012.
23) Kaiser Family Foundation. Medicaid and managed care. Available at http://www.kff.org/medicaid/upload/8046-02.pdf. Accessed January 20, 2013.
24) Khanna R, Madhavan SS, Bhanegaonkar A, Remick SC. Prevalence, healthcare utilization, and costs of breast cancer in a state Medicaid fee-for-service program. J Womens Health 2011;20:739-747.
25) Lambe M, Hsieh C, Tsaih S, Ekbom A, Adami HO, Trichopoulos D. Maternal risk of breast cancer following multiple births: a nationwide study in Sweden. Cancer Causes Control 1996;7:533-538.
26) Landon BE, Epstein AM. Quality management practices in Medicaid managed care. JAMA 1999;282:1769-1775.
27) Maughan KL, Lutterbie MA, Ham PS. Treatment of breast cancer. Am Fam Physician 2010,81:1339-1346.
28) Max W, Sung HY, Stark B. The economic burden of breast cancer in California. Breast Cancer Res Treat 2009;116:201-207.
29) Mullins CD, Cooke JL, Wang J, Shaya FT, Hsu DV, Brooks S. Disparities in prevalence rates for lung, colorectal, breast, and prostate cancers in Medicaid. J Natl Med Assoc 2004;96:809-816.
30) Piecoro LT, Potoski M, Talbert JC, Doherty DE. Asthma prevalence, cost, and adherence with expert guidelines on the utilization of health care services and costs in a state Medicaid population. Health Serv Res 2001;36:357-371.
31) Research Data Assistance Center. Brief descriptions of MAX files. Available at http://www.resdac.org/Medicaid/file_descriptions.asp. Accessed July 25, 2012.
32) Rowland D. Medicaid at Forty. Health Care Financ Rev 2005-2006;27:2:63-77.
33) Russo CA, VanLandeghem K, Davis PH, Elixhauser A. Hospital and Ambulatory Surgery Care for Women's Cancers. HCUP Highlight #2. Rockville, MD: Department of Health and Human Services, Agency for Healthcare Research and Quality. September 2006. AHRQ Pub. No. 06-0038.

34) Sasser AC, Rousculp MD, Birnbaum HG, Oster EF, Lufkin E, Mallet D. Economic burden of osteoporosis, breast cancer, and cardiovascular disease among postmenopausal women in an employed population. Womens Health Issues 2005;15:97-108
35) Siegel R, DeSantis C, Virgo K, Stein K, Mariotto A, Smith T, Ward E. Cancer treatment and survivorship statistics, 2012. CA Cancer J Clin 2012;62:220-241.
36) Smith-Warner SA, Spiegelman D, Yaun SS, et al. Alcohol and breast cancer in women: a pooled analysis of cohort studies. JAMA 1998;279:535-540.
37) United States Department of Agriculture. Rural-urban continuum codes. Available at http://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx. Accessed July 25, 2012.

CHAPTER 3

IMPACT OF PRE-EXISTING MENTAL ILLNESSES ON RECEIPT OF GUIDELINE-CONSISTENT BREAST CANCER TREATMENT AND HEALTHCARE UTILIZATION AMONG WOMEN DIAGNOSED WITH BREAST CANCER

Introduction

Breast cancer is the most common cancer among women, after skin cancer. Breast cancer is also the second leading cause of cancer-related mortality in women, exceeded only by lung cancer (American Cancer Society [ACS]). In the year 2013, roughly 300,000 incident cases of breast cancer were expected to occur and 39,620 women were estimated to die from breast cancer in the United States (US) (ACS). It has been estimated that nearly 12% of the women in the US will develop breast cancer in their lifetime (ACS). Despite being associated with considerable morbidity and mortality, breast cancer is one of the most treatable cancers if detected early. The primary treatment of breast cancer consists of surgical removal of the tumor. Some of the aggressive types of breast cancer surgeries include radical mastectomy, modified radical mastectomy, and total mastectomy. These procedures involve removal of the whole breast that has cancer. A relatively less aggressive surgical breast cancer treatment regimen is breast-conserving surgery, a procedure performed to remove the cancer but not the breast itself. Adjuvant treatments such as radiotherapy, hormonal therapy, chemotherapy, and tissue-targeted therapies have been found to reduce the likelihood of breast cancer recurrence and are an integral part of the breast cancer treatment regimen (Maughan et al., 2010).

Major medical organizations, including the American Society of Clinical Oncology (ASCO), the National Comprehensive Cancer Network (NCCN), and the National Institute of Health (NIH), have issued guidelines for the treatment of breast cancer in order to inform physicians about the state-of-the-art breast cancer treatments and facilitate standard management of breast cancer patients (Iyengar et al., 2010). These guidelines are based on the breast cancer clinical research conducted over the past few decades **(**Ragaz et al., 1997, Overgaard et al., 1997, Fisher et al., 2002, Goss et al., 2003, Romond et al., 2005, Fisher et al., 2006, Coates et al., 2007, Smith et al., 2007). Some of the main guidelines issued by these organizations include the use of radiotherapy after breast conserving surgery in patients with stage I and stage II breast cancers (NIH consensus guidelines for the treatment of breast cancer, 1990, Recht et al., 2001, NCCN, 2006, Maughan et al., 2010), radiotherapy after total mastectomy in patients with tumor size greater than 5 cm and/or tumor that has spread to four or more axillary lymph nodes (NCCN, 2006), chemotherapy drugs (e.g., taxanes, anthracyclines, and cyclophosphamide) in patients with lymph node positive breast cancer or those with tumors larger than 1 cm (NCCN, 2006, Maughan et al., 2010), hormonal therapies such as selective estrogen receptor modulators (e.g., tamoxifen) and aromatase inhibitors (e.g., anastrazole, letrozole, and exemestane) in patients with estrogen receptor-positive breast cancer (NCCN, 2006, Burstein et al., 2010, Maughan et al., 2010), and tissue-targeted therapies (e.g., trastuzumab) in women with Human Epidermal Growth Factor Receptor 2 (HER2) positive breast cancer (NCCN, 2006, Maughan et al., 2011).

Receipt of breast cancer treatment, which is compliant with the established breast cancer treatment guidelines, is crucial for optimal survival in breast cancer patients (Herbert-Croteau et al., 2004, Maskarinec et al., 2011). However, despite these treatment guidelines, studies have reported that up to 55% of the women with breast cancer do not receive treatment compliant with

these guidelines (Bloom et al., 2004, Landercasper et al., 2006, Foley et al., 2007, Worthington et al., 2008, Iyengar et al., 2010, Shirvani et al., 2011).

An important first step towards improving the treatment of breast cancer patients is developing an understanding of factors affecting receipt of guideline-consistent breast cancer treatment. Various patient and healthcare-related characteristics have been found to be associated with receipt of guideline-consistent breast cancer treatment in prior studies. Individual characteristics such as younger age (Ballard-Ballash et al., 1996, Haggstorm et al., 2005, Voti et al., 2006, Anderson et al., 2008, Chagpar et al., 2008, Rosato et al., 2009, Jagsi et al., 2010, Chien et al., 2012), Caucasian race (Haggstorm et al., 2005, Voti et al., 2006, Smith et al., 2010, Freedman et al., 2011), being married (Voti et al., 2006), residence in a metropolitan area (Haggstorm et al., 2005, Worthington et al., 2008), possession of insurance (Voti et al., 2006, Freedman et al., 2011), fewer comorbidities (Ballard-Barbash et al., 1996, Rosato et al., 2009, Jagsi et al., 2010), and prior use of mammography (Smith et al., 2010) have been associated with receipt of guideline-consistent breast cancer treatment. Hospital related characteristics, including number of breast cancer-related surgical procedures conducted annually (Rosato et al., 2009, Chien et al. 2012), membership in multiple National Cancer Institute-funded research networks (Laliberte et al., 2005), non-teaching status (Voti et al., 2006), and hospital size (Satariano et al., 1992, Grilli et al., 1994, Guadagnoli et al., 1998), have been found to positively impact receipt of guideline-consistent breast cancer treatment. Healthcare access-related variables such as the number of primary care physicians and the number of radiologists in the healthcare service area have also been shown to be positively associated with receipt of guideline-consistent breast cancer treatment (Ballard-Ballash et al., 1996).

While these studies provide useful information, limited information currently exists about the impact of pre-existing mental illnesses on the receipt of guideline-consistent breast cancer treatment. About one in four adults in the US have a mental illness and nearly 50% will develop at least one mental illness in their lifetime (Kessler et al., 2005, Reeves et al., 2011). Due to health-related issues such as poor eating and sleeping habits, lack of exercise, indulgence in smoking, alcohol, and drug abuse, and impaired immune system, individuals with mental illnesses are more likely to develop comorbid physical conditions (Kendrick, 1996, Osborn, 2001, Mitchell et al., 2009). Higher incidence of breast cancer has been reported in individuals with mental illness as compared to those without any mental illness (McGinty et al., 2012). The impairment of cognitive, emotional, and/or behavioral functioning in patients with mental illnesses could affect their receipt of mental and physical healthcare services.

A thorough review of the literature yielded only one study evaluating the impact of pre-existing mental illnesses on receipt of guideline-consistent breast cancer treatment. Goodwin et al. (2004) evaluated the effect of pre-existing depression on breast cancer treatment among elderly Medicare beneficiaries with breast cancer. Women with pre-existing depression were 19% more likely to receive treatment non-consistent with established standards of breast cancer care (simple mastectomy or breast-conserving surgery plus adjuvant irradiation for Stage 0, modified radical mastectomy or breast-conserving surgery with axillary dissection and adjuvant irradiation for Stage I or II, and chemotherapy for Stages III or IV) as compared to women without pre-existing depression. While the work conducted by Goodwin et al. (2004) provided useful information, the authors did not consider the impact of other mental illnesses in the study. In addition, the authors only studied this relationship among elderly women.

Besides guideline-consistent breast cancer treatment, another treatment-related attribute, crucial for optimal health outcomes in breast cancer patients, is the healthcare utilization during breast cancer treatment. Frequent contact with the healthcare system during breast cancer treatment in the form of regular physician office visits and necessary hospital stays is necessary for timely delivery of healthcare and prevention of unplanned hospital visits and ER visits. While factors such older age at diagnosis, higher educational level, lower quality of life, not having children, and receipt of hormonal therapy and chemotherapy have been found to be associated with healthcare utilization post diagnosis in breast cancer patients (Keyzer-Dekker et al., 2012, Roorda et al., 2012), no information is currently available about the impact of pre-existing mental illnesses on healthcare utilization post diagnosis in breast cancer patients.

The current study determined the impact of pre-existing mental illnesses on the receipt of guideline-consistent breast cancer treatment and breast cancer-related healthcare utilization among women Medicaid enrollees diagnosed with breast cancer. Effect of mental illnesses, including mood disorders (e.g., bipolar affective disorders, dysthymic disorder, major depressive disorder, and adjustment reactions), psychotic disorders (e.g., schizophrenia, paranoid states, and non-organic psychoses), substance abuse and dependence disorders, and other mental disorders, on receipt of guideline-consistent breast cancer treatment (breast conserving surgery followed by radiation therapy or total mastectomy with or without radiation therapy for Stage I and II breast cancers and chemotherapy for Stages III and IV breast cancers) (NCCN, 2006) was evaluated in the study. In addition, the impact of pre-existing mental illnesses on breast cancer-related healthcare utilization during the initial 12 months following diagnosis of breast cancer was determined.

Methods

Data source

The current study used the data from the 2006-2008 Medicaid analytic extract (MAX) files. The MAX files for 39 states (all states except Alaska, Hawaii, Maine, Missouri, Montana, North Dakota, Pennsylvania, South Dakota, Utah, Wisconsin, Wyoming, and District of Columbia) were used in this study. The MAX files are created from the Medicaid Statistical Information System (MSIS) and are maintained by the Centers for Medicare and Medicaid service (CMS). Information about patient demographics, eligibility, and enrolment status was available through the MAX personal summary file. Claims for inpatient services received by the recipients were provided through the MAX inpatient file, whereas information about the non-institutional services received by the Medicaid enrollees was made available through the MAX other therapy file. Details about the prescription drugs dispensed to the recipients were provided through the MAX prescription drug file. All the files were linked using a unique encrypted recipient identification number. All data were made available to the researcher in a deidentified format. Study protocol was approved by the Institutional review board (IRB) at University of Mississippi. Data use agreement (DUA) was obtained from CMS through Research Data Assistance Center (ResDAC).

Study sample

The target population for the study consisted of women Medicaid enrollees who were: (1) continuously enrolled in Medicaid during the years 2006-2008; (2) at least 18 years of age on January 01, 2006 and less than 65 years of age on December 31, 2008; and (3) newly diagnosed with breast cancer between January 01, 2007 and December 31, 2007. Women less than 18

years of age were excluded from study analysis since breast cancer is rare in adolescent women. In addition, the study excluded women aged 65 years or more since Medicare is the primary payer in these individuals. Dual eligibles, i.e., women aged less than 65 years enrolled in both Medicare and Medicaid, were also excluded from the study due to incomplete data in MAX files. Women newly diagnosed with breast cancer were identified using an algorithm developed by Solin et al. (1994). As per this algorithm, a case of breast cancer was defined as a new case if the medical utilization data between January 01, 2007 and December 31, 2007 met one or more of the following six treatment-related criteria: (1) mastectomy (current procedural terminology 4th edition [CPT-4] codes of 19180-19240); (2) partial mastectomy with lymphadenectomy (CPT-4 code of 19162); (3) excision (CPT-4 code of 19120, 19125, or 19126), breast biopsy (CPT-4 code of 19100 or 19101), or partial mastectomy (CPT-4 code of 19160) plus lymphadenectomy (CPT-4 code of 38740 or 38745); (4) excision, breast biopsy, or partial mastectomy plus diagnosis of carcinoma (International Classification of Diseases, ninth revision, clinical modification [ICD-9-CM] codes of 174-174.9 or 233.0); (5) excision, breast biopsy, or partial mastectomy followed by radiation therapy (CPT-4 codes of 77261-77499); or (6) excision, breast biopsy, or partial mastectomy followed by chemotherapy (CPT-4 codes of 96400-96549). The date of the first record with a diagnosis of breast cancer (ICD-9-CM codes of 174, 233.0, 238.3, and 239.3) for each breast cancer case was considered as the diagnosis date. The medical records for the cases identified using Solin's algorithm were monitored to determine if there were any breast cancer diagnosis prior to their initial diagnosis. Only those cases without any prior medical record with a diagnosis of breast cancer were considered as incident cases.

Measures

Receipt of guideline-consistent breast cancer treatment was determined based on compliance with the established guidelines for the treatment of breast cancer (NCCN, 2006). Individuals diagnosed with stage I and II breast cancer, who received breast conserving surgery followed by radiation therapy or total mastectomy with or without radiation therapy, were considered as having received guideline-consistent breast cancer treatment. Receipt of chemotherapy for stage III and IV breast cancer patients was considered as guideline-consistent breast cancer treatment. The observation period for measuring guideline-consistent breast cancer treatment was 12 months post the diagnosis of breast cancer. Breast conserving surgery was identified from the medical utilization data using CPT-4 codes of 19120-19126, 19160-19162, 19180, 19182, 19200, 19220, 19240, 19260, 19271, 19272, 19290-19298, 19316-19396, and 19499 and ICD-9-CM procedure codes of 8520-8525, 8534-8536, 8541-8548, and 8663. Total mastectomy was determined using CPT-4 code of 19180 and ICD-9-CM procedure codes of 85.41-85.44. Radiation therapy was determined based on CPT-4 codes of 77261-77418, 77427-77499, and 77520-77525, ICD-9-CM procedure codes of 9221-9226, and ICD-9-CM diagnosis codes of V580, V661, and V671. Use of chemotherapy was identified from the medical records with associated HCPCS codes of J8520 and J8521 (capecitabine), J8530 (oral cyclophosphamide), J9070-J9097 (cyclophosphamide), J9190 (5-flurouracil), J9260 and J9250 (methotrexate), J9201 (gemcitabine), J9390 (vinorebine), J9265 (paclitaxel), J9170 (docetaxel), J9000 and J9001 (doxorubicin), J9178 (epirubicin), J9045 (carboplatin), J9060 and J9062 (cisplatin), and J9355 (trastuzumab), ICD-9-CM procedure code of 9225, and ICD-9-CM diagnosis code of V581, V662, and V672. In addition, records from the prescription claims data with national drug codes (NDCs) for the above mentioned chemotherapy drugs were used to identify chemotherapy use

(Barron et al., 2008). Guideline-consistent breast cancer treatment was considered as a dichotomous variable.

Breast cancer-related healthcare utilization among recipients diagnosed with breast cancer was determined in the form of total number of breast cancer-related inpatient, outpatient, and emergency room (ER) visits during 12 months after the diagnosis of breast cancer. An inpatient visit was considered to be breast cancer-related if the primary diagnosis code associated with the record was for breast cancer (ICD-9-CM code of 174, 233.0, 238.3, or 239.3). Outpatient and ER visits were considered to be breast cancer-related if the primary and/or secondary diagnosis code associated with the records were for breast cancer. The 2007 and 2008 MAX inpatient and other therapy files were used for identifying breast cancer-related healthcare utilization. Observations listed in the inpatient file were considered as inpatient visits. The MAX inpatient file is an event-level file and hence each observation was considered as one visit. Observations with place of service codes of 11 (office), 22 (outpatient hospital), 24 (ambulatory service center), 50 (federally qualified health center), 71 (state or local public health clinic), or 72 (rural health clinic) and type of service codes of 08 (physicians), 10 (other practitioners), 11 (outpatient hospital), 12 (clinic), 37 (nurse practitioner services) or those with procedure codes 99201-99215, 99241-99245, 99354-99355, 99381-99429 in the other therapy file were classified as outpatient visits. The MAX other therapy file is a claim-level file, and hence outpatient visits were defined based on the date of service. If a recipient had one or more observations on a particular day that conformed to the above mentioned criteria, she was considered to have had an outpatient visit on that day. Observations with place of service code of 23 in the other therapy file and those with revenue code of 450-459 or procedure codes of 99281-99285 in the other

therapy file or inpatient file were considered as ER visits. Breast cancer-related inpatient, outpatient, and ER visits were considered as continuous variables.

Pre-existing mental illnesses were identified based on the ICD-9-CM diagnosis codes associated with the medical records during 12 months prior to the date of diagnosis of breast cancer. Four categories of mental illnesses were considered in this study: all mood disorders (ICD-9-CM codes 296.0, 296.1, 296.2, 296.3, 296.4, 296.5, 296.6, 296.7, 296.80, 296.81, 296.89, 296.9, 300.4, 301.12, 301.13, 309.0, 309.1, 309.4, 311), all psychotic disorders (ICD-9-CM codes 293.81, 293.82, 295, 297, 298), substance abuse and dependence disorders (ICD-9-CM codes 291.0-291.1, 291.3-291.9, 292, 303, 304, 305), and other mental disorders that did not fall into the above categories (ICD-9-CM codes 290.00-319.99) (Baillargeon et al., 2011). Recipients with ICD-9-CM codes for mental illnesses in any position on the records in the MAX inpatient and other therapy files were considered as having a mental illness.

Other variables included in the study were age at diagnosis, race, the type of reimbursement system, breast cancer stage at diagnosis, Charlson comorbidity index (CCI), location of residence, state of residence, and the number of outpatient visits in the 12 months prior to diagnosis of breast cancer. Age at diagnosis was considered as a continuous variable. Race was categorized into white, black, Hispanic or Latino, Asian, Native Hawaiian or other Pacific islander, American Indian or Alaskan Native, and others (consisting of more than one race and unknown race). The type of reimbursement system consisted of categories of FFS only (recipients who were enrolled in FFS Medicaid during 2006-2008) and managed care (recipients who were enrolled in Medicaid managed care for at least one month during 2006-2008). The stage of breast cancer at diagnosis was identified using an algorithm developed by Yuen et al. (2006), which is based on ICD-9-CM codes. The breast cancer staging criteria stated in Yuen's

algorithm have been listed in Appendix 1. The comorbidity profile of the study sample was measured using CCI (D'Hoore adaptation). CCI was calculated based on the medical records of the recipients during the period of 12 months prior to breast cancer diagnosis. Mental illnesses were excluded from CCI calculation. The state of residence consisted of 39 categories. The location of residence was categorized as metropolitan, suburban, rural, and unknown and was defined for each recipient based on the United States Department of Agriculture (USDA) rural-urban continuum codes: metropolitan location (codes 0-3), suburban location (codes 4-5), and rural location (codes 6-9). The rural-urban continuum codes were determined based on the Federal Information Processing Standard (FIPS) code for the county of residence listed for each recipient in the 2006 MAX personal summary file. The number of outpatient visits during 12 months prior to the date of diagnosis of breast cancer was calculated based on records in the MAX other therapy files and was considered as a continuous variable.

Statistical analysis

Bivariate analyses were conducted for comparison of breast cancer patients with and without mental illnesses using chi-square tests for categorical variables and Student t test for continuous variables including age at diagnosis and CCI. Wilcoxon rank sum test was used for the comparison of number of outpatient visits during 12 months prior to breast cancer diagnosis between breast cancer patients with mental illnesses and those without mental illnesses. Means and standard deviations were reported for continuous variables and frequencies and percentages were reported for categorical variables. Hierarchical logistic regression was used to determine the impact of pre-existing mental illnesses on the receipt of guideline-consistent breast cancer care. Unadjusted and adjusted analyses were performed. Odds ratios and 95% confidence

intervals were reported. The impact of pre-existing mental illnesses on breast cancer-related healthcare utilization was examined using mixed effects Poisson regression or negative binomial regression. Unadjusted and adjusted analyses were performed. The decision about using Poisson or negative binomial regression was based on the dispersion parameter (chi-square/degrees of freedom) observed after fitting the Poisson regression model. Poisson regression was used in cases where the dispersion parameter was ~1, whereas negative binomial regression was used if the value of the dispersion parameter was found to be greater than 1. Separate models were fitted with breast cancer-related inpatient, outpatient, and ER visits as the dependent variables. Incident rate ratios and 95% confidence intervals were reported. Apart from measuring the impact of any pre-existing mental illness, separate models were fitted for the individual categories of pre-existing mental illness (mood disorders, psychotic disorders, substance abuse and dependence disorders, and other mental disorders). All the covariates mentioned earlier were adjusted for in each of the models. The random effects of the state and county of residence were included in all the models. All analyses were performed using Statistical Analysis System (SAS) version 9.2 (SAS Institute Inc., Cary, NC). The SAS procedure PROC GLIMMIX was used for fitting the multivariable models.

Results

The socio-demographic and clinical characteristics of the study sample are presented in Table 3.1. We identified 2,142 incident cases of breast cancer in the Medicaid population in the calendar year 2007. Of these, approximately 42.5% were white and 25.2% were black. Nearly 92% of the recipients were enrolled in Medicaid managed care for at least one month during 2006-2008. Majority of the respondents (81.7%) lived in metropolitan areas. Most (71.2%)

were diagnosed with stage I cancer. The mean age at diagnosis of the sample was 50.41 years (±8.58). The mean CCI was 1.12 (±1.68). The mean number of outpatient visits during 12 months prior to breast cancer diagnosis was 12.45 (±11.59). Of the 2,142 incident breast cancer cases, roughly 38% (N = 806) had a pre-existing mental disorder. The baseline demographic and clinical characteristics of breast cancer cases with and without mental disorders are presented in Table 3.1. The mean age of recipients with mental illnesses was higher than those without any mental illness (50.86 years [±8.06] vs. 50.12 years [±8.89], $p = 0.047$). A greater percentage of recipients with mental illnesses were white (52.51% vs. 35.99%, $p < 0.0001$) as compared to those without any mental disorders, whereas the percentage of blacks (27.57% vs. 21.41%, $p < 0.0001$), Hispanics/Latinos (13.40% vs. 8.73%, $p < 0.0001$), and Asians (6.20% vs. 0.96%, $p < 0.0001$) was greater in recipients without any pre-existing mental disorders as compared to those without at least one pre-existing mental disorder. A higher proportion of recipients with pre-existing mental illnesses were enrolled in Medicaid managed care for at least one month during 2006-2008 as compared to those without any pre-existing mental illness (12.80% vs. 7.20%, $p < 0.0001$). Greater percentage of recipients without any pre-existing mental illness resided in metropolitan areas as compared to those with a pre-existing mental illness (83.92% vs. 81.14%, $p = 0.0042$). No statistically significant difference was observed in the breast cancer stage at diagnosis between recipients with and without pre-existing mental illnesses. The mean CCI was higher in recipients with mental illnesses than those without any mental illness (1.27 [±1.69] vs. 1.02 [±1.67], $p = 0.0007$). The mean number of outpatient visits during 12 months prior to breast cancer diagnosis was higher in recipients with one or more mental illnesses than those without any mental illness (15.64 [±12.94] vs. 10.41 [±10.13], $p < 0.0001$).

Table 3.1. Demographic and clinical characteristics of the study sample

Characteristic	All (N = 2,142)	No mental disorder (N = 1,306)	Any mental disorder (N = 806)	p
Age at diagnosis, Mean (SD)	50.41(8.58)	50.12(8.89)	50.86(8.06)	0.047
Race, N (%)				< 0.0001
White	909 (42.44)	470 (35.99)	439 (52.51)	
Black	539 (25.16)	360 (27.57)	179 (21.41)	
Hispanic or Latino	248 (11.58)	175 (13.40)	73 (8.73)	
Asian	89 (4.15)	81 (6.20)	8 (0.96)	
Native Hawaiian or other Pacific islander	36 (1.68)	22 (1.68)	14 (1.67)	
American Indian or Alaskan native	26 (1.21)	16 (1.23)	10 (1.20)	
Others	295 (13.77)	182 (13.94)	113 (13.52)	
Type of reimbursement system				< 0.0001
FFS only	201 (9.38)	94 (7.20)	107 (12.80)	
Managed care[a]	1,941 (90.62)	1,212 (92.80)	729 (87.20)	
Location, N (%)				0.0042
Metropolitan	1,750 (81.70)	1,096 (83.92)	654 (81.14)	
Suburban	136 (6.35)	72 (5.51)	64 (7.94)	
Rural	225 (10.50)	125 (9.57)	100 (12.41)	
Unknown	31 (1.45)	13 (1.00)	18 (2.23)	
Stage, N (%)				0.0564
0	46 (2.15)	28 (2.14)	18 (2.15)	
I	1525 (71.20)	904 (69.22)	621 (74.28)	
II	378 (17.65)	239 (18.30)	139 (16.63)	
III	14 (0.65)	10 (0.77)	4 (0.48)	
IV	179 (8.36)	135 (9.57)	54 (6.46)	
CCI, Mean (SD)	1.12 (1.68)	1.02 (1.67)	1.27 (1.69)	0.0007
Number of physician visits during 12 months prior to breast cancer diagnosis	12.45 (11.59)	10.41 (10.13)	15.64 (12.94)	< 0.0001

SD: standard deviation
FFS: fee-for-service
[a]The category managed care comprised of recipients enrolled in Medicaid managed care for at least one month during the study period (2006-2008)

The results of hierarchical logistic regression analyses conducted to determine the impact of pre-existing mental illnesses on receipt of guideline-consistent breast cancer treatment have been presented in Table 3.2. In the multivariable analyses, recipients with one or more pre-existing mental illnesses were found to be 20.7% less likely to receive guideline-consistent breast cancer treatment (adjusted odds ratio [AOR] = 0.793, 95% confidence interval [CI] = 0.646 – 0.973) as compared to those without any mental illness. In terms of individual mental illness categories, recipients with mood disorders were 24.7% less likely to receive guideline-consistent breast cancer treatment (AOR = 0.753, 95% CI = 0.585 – 0.970) as compared to those without any mental illness. Recipients with other mental disorders were 31.7% less likely to receive guideline-consistent breast cancer treatment (AOR = 0.683, 95% CI = 0.531 – 0.879) as compared to those without any mental illness. There was no statistically significant difference in the odds of receiving guideline-consistent breast cancer treatment between recipients with psychotic disorders and substance abuse and dependence disorders and those without any pre-existing mental disorders.

Table 3.2. Hierarchical logistic regression for determination of impact of pre-existing mental illnesses on guideline-consistent breast cancer treatment

	Odds ratio	
Mental illness	**Unadjusted**	**Adjusted**
No mental illness	Reference	Reference
Any mental illness	0.806 (0.673 – 0.967)	0.793 (0.646 – 0.973)
Mood disorders	0.764 (0.602 – 0.970)	0.753 (0.585 – 0.970)
Psychotic disorders	0.977 (0.667 – 1.431)	0.939 (0.635 – 1.390)
Substance abuse and dependence disorders	0.743 (0.526 – 1.051)	0.805 (0.559 – 1.159)
Other mental disorders	0.688 (0.542 – 0.873)	0.683 (0.531 – 0.879)

The results of Poisson/negative binomial regression analyses conducted to determine the impact of pre-existing mental illnesses on utilization of breast cancer-related inpatient services have been presented in Table 3.3. In the multivariable analyses, no statistically significant differences were found in terms of number of inpatient visits between recipients with and without any pre-existing mental illnesses. Similar results were obtained in the analyses conducted to determine the impact of individual mental illness categories on breast cancer-related inpatient utilization. Table 3.4 represents the results of Poisson/negative binomial regression analyses conducted to determine the impact of pre-existing mental illnesses on breast cancer-related outpatient visits. In the multivariable analyses, recipients with one or more pre-existing mental illnesses had 8.3% lesser number of outpatient visits (adjusted incident rate ratio [AIRR] = 0.917, 95% CI = 0.892 – 0.942) as compared to those without any mental illness. The analyses conducted to determine the impact of individual mental illness categories on breast cancer-related outpatient utilization yielded similar results. Recipients with pre-existing mood disorders had 7.3% lesser number of outpatient visits (AIRR = 0.927, 95% CI = 0.897 – 0.958) as compared to those without any mental illness. Recipients with psychotic disorders had 17.1% lesser number of outpatient visits (AIRR = 0.829, 95% CI = 0.784 – 0.877) as compared to those without any mental illness. Recipients with substance abuse and dependence disorders had 8.5% lesser number of outpatient visits (AIRR = 0.915, 95% CI = 0.866 – 0.966) as compared to those without any mental illness. The number of outpatient visits was 7.4% (AIRR = 0.926, 95% CI = 0.894 – 0.958) lesser among recipients with other mental illnesses as compared to recipients without any pre-existing mental illness.

Table 3.3. Mixed effects Poisson/negative binomial regression for determination of impact of pre-existing mental illnesses on breast cancer-related inpatient visits

	Incident rate ratio	
Mental illness	**Unadjusted**	**Adjusted**
No mental illness	Reference	Reference
Any mental illness	0.932 (0.804 – 1.081)	0.993 (0.851 – 1.159)
Mood disorders	0.851 (0.710 – 1.020)	0.906 (0.749 – 1.097)
Psychotic disorders	0.943 (0.712 – 1.242)	1.001 (0.753 – 1.330)
Substance abuse and dependence disorders	1.034 (0.800 – 1.337)	1.147 (0.877 – 1.500)
Other mental disorders	0.990 (0.828 – 1.184)	1.060 (0.880 – 1.278)

Table 3.4. Mixed effects Poisson/negative binomial regression for determination of impact of pre-existing mental illnesses on breast cancer-related outpatient visits

	Incident rate ratio	
Mental illness	**Unadjusted**	**Adjusted**
No mental illness	Reference	Reference
Any mental illness	0.882 (0.860 – 0.905)	0.917 (0.892 – 0.942)
Mood disorders	0.879 (0.852 – 0.908)	0.927 (0.897 – 0.958)
Psychotic disorders	0.792 (0.750 – 0.837)	0.829 (0.784 – 0.877)
Substance abuse and dependence disorders	0.835 (0.792 – 0.880)	0.915 (0.866 – 0.966)
Other mental disorders	0.908 (0.879 – 0.938)	0.926 (0.894 – 0.958)

The results of Poisson/negative binomial regression analyses conducted to determine the impact of pre-existing mental illnesses on utilization of breast cancer-related emergency room services have been presented in Table 3.5. In the multivariable analyses, recipients with any pre-existing mental illnesses had 15.8% lesser number of emergency room visits (AIRR = 0.842, 95% CI = 0.709 – 0.999) as compared to those without any mental illness. No statistically significant differences were observed in the number of emergency room visits between recipients belonging to individual mental illness categories and those without any mental illnesses.

Table 3.5. Mixed effects Poisson/negative binomial regression for determination of impact of pre-existing mental illnesses on breast cancer-related emergency room visits

	Incident rate ratio	
Mental illness	**Unadjusted**	**Adjusted**
No mental illness	Reference	Reference
Any mental illness	0.744 (0.636 – 0.870)	0.842 (0.709 – 0.999)
Mood disorders	0.769 (0.632 – 0.935)	0.978 (0.790 – 1.209)
Psychotic disorders	0.704 (0.482 – 1.030)	0.667 (0.431 – 1.031)
Substance abuse and dependence disorders	0.795 (0.566 – 1.119)	0.749 (0.508 – 1.103)
Other mental disorders	0.936 (0.787 – 1.113)	1.221 (0.850 – 1.752)

Discussion

Receipt of healthcare conforming to the established breast cancer treatment guidelines is crucial for optimal health outcomes in breast cancer patients. However, it has been reported that more than two-fifth of the breast cancer patients do not receive the recommended healthcare. An understanding of factors affecting breast cancer treatment consistent with the established standards is important for planning steps towards eliminating disparities in the treatment of breast cancer patients. The current study advances the knowledge about factors affecting guideline-consistent breast cancer treatment by examining the impact of pre-existing mental illnesses on the receipt of guideline-consistent breast cancer treatment among Medicaid enrollees diagnosed with breast cancer. In addition, the impact of pre-existing mental illnesses on breast cancer-related healthcare utilization (inpatient, outpatient, and ER visits) among newly diagnosed cases of breast cancer in the Medicaid population was determined. Although a previous study had determined the impact of depression on guideline-consistent breast cancer treatment in elderly breast cancer patients (Goodwin et al., 2004), the current study is the first to evaluate the impact of all major mental illnesses on guideline-consistent breast cancer treatment.

Also, this is the first study to determine the impact of pre-existing mental illnesses on healthcare utilization in breast cancer patients.

Recipients with a pre-existing mental illness were 20.7% less likely to receive guideline-consistent breast cancer treatment as compared to recipients without any pre-existing mental illness. Similar results were obtained in the analyses conducted to determine the impact of individual mental illness categories on receipt of guideline-consistent breast cancer treatment. The odds ratios did not reach statistical significance for psychotic disorders and substance abuse and dependence disorders, which could be due to the low statistical power given the low sample size in these groups. Similar to our study, Goodwin et al. (2004) found that pre-existing depression was associated with 19% higher odds of non-guideline-consistent breast cancer treatment in their study of elderly breast cancer patients. Studies in other cancers (Baillargeon et al., 2011, Boyd et al., 2012) and other disease areas (Druss et al., 2000, Frayne et al., 2005) have found negative association between pre-existing mental illnesses and guideline-consistent treatment. Various patient- and provider-level characteristics can explain the negative association between presence of pre-existing mental illnesses and receipt of guideline-consistent breast cancer treatment observed in our study. Impaired cognitive ability and poor communication skills in patients with mental illnesses could be responsible for less understanding of the treatment regimen. Social isolation and listlessness could lead to lack of motivation to undergo treatments. Disorganized thought processes could hinder the receipt of follow-up treatments (Baillargeon et al., 2011). Patients with conditions such as paranoia, delirium, and dementia can wrongly perceive certain established treatments as life-threatening and thereby not consent their receipt (Mitchell et al., 2009, Lawrence and Kisely, 2010, Baillargeon et al., 2011). In terms of provider-level factors, the stigma associated with the

treatment of patients with mental illnesses could cause providers to treat patients with mental illnesses differently as compared to patients without mental illnesses. Also, physicians providing breast cancer treatment to patients with mental illnesses may not have time and/or skills to provide care to these patients (Phelan et al., 2002, Mitchell et al., 2009, Howard et al., 2010, Lawrence and Kisely, 2010, Chadwick et al., 2012).

Interesting results emerged from the multivariable regression analyses conducted to determine the impact of pre-existing mental illnesses on breast cancer-related healthcare utilization. The association between presence of any pre-existing mental illnesses and breast cancer-related inpatient utilization was not statistically significant. Similar results were obtained in the analyses examining the impact of individual mental illness categories on breast cancer-related inpatient utilization. However, a negative association was observed between presence of pre-existing mental illnesses and breast cancer-related outpatient visits. The results were consistent for the composite variable of any pre-existing mental illnesses as well as the individual mental illness categories. Most of the breast cancer treatments including surgical treatments and systemic adjuvant therapies are provided in outpatient settings due to technological developments in breast cancer treatment. In general, only a few patients undergoing mastectomies and axillary lymph node dissections are treated in inpatient facilities (Russo et al., 2006). This fact was also evident in this study with outpatient visits accounting for over 96% of the breast cancer-related healthcare use. Also, only ~29.4% of the study sample had inpatient visits and the average number of inpatient visits among these recipients was 1.30 (±0.60). Considering these facts, the negative association between pre-existing mental illnesses and breast cancer-related outpatient visits observed in this study is indicative of the disparities experienced by breast cancer patients with pre-existing mental illnesses in terms of breast

cancer-related healthcare utilization. It is likely that lower number of outpatient visits among women with breast cancer with pre-existing mental illnesses contribute towards their lack of guideline-consistent treatment. Not undergoing regular office visits may negatively impact their treatment.

Negative association was observed between presence of any pre-existing mental illnesses and utilization of breast cancer-related emergency room services. Though unexpected, this finding may be explained by the possibility of lower incidence of treatment-related toxicities among those with pre-existing mental illnesses due to lower use of breast cancer treatments as compared to those without any pre-existing mental illness.

The findings of this study have important practical implications. The negative association between pre-existing mental illnesses and guideline-consistent breast cancer treatment and breast cancer-related healthcare utilization observed in this study emphasizes the need for more focused care of breast cancer patients with mental illnesses. Strategies that rectify the negative effects of mental illnesses such as physician counseling, healthcare skills training, peer-led counseling and help in accessing healthcare, and support from family members could be helpful in reducing the healthcare disparities in these individuals (Lawrence and Kisely, 2010). Provision of integrated healthcare by involvement of mental health professionals during the breast cancer treatment phase could also be helpful in improving breast cancer treatment in these individuals. This could be done by having the mental health professionals visit the concerned oncologist/physician during the patient visits or appointing case managers, who serve as a liaison between the specialties and co-ordinate the treatment of the patient (Lawrence and Kisely, 2010).

The current study had a few limitations. Coding errors are possible while processing of administrative claims, which could have impacted the results of the study. Individuals enrolled

in both Medicare and Medicaid were not included in the study since Medicare is the primary payer for these individuals and complete information about their medical care is not contained in the MAX files. Therefore, the results obtained from this study are not representative of the entire Medicaid population in the states included in the study. The incident cases of breast cancer and cancer stage were identified using algorithms developed by Solin et al. (1994) and Yuen et al. (2011). Though these algorithms have been associated with favorable measurement properties in different patient populations, they have not been validated in the Medicaid population. Mental illnesses were identified using medical claims data and ICD-9-CM diagnostic codes, which might have underestimated the true prevalence, since physicians often underrecognize some of the mental illnesses such as depression and dementia (Davidson et al., 1999, Raji et al., 2008, Baillargeon et al., 2011). Further, we did not consider the role of medication (mental health-related) adherence on receipt of guideline-consistent breast cancer treatment. While several studies have used medical records during two years to identify mental illnesses (Goodwin et al., 2004, Frayne et al., 2005, Baillargeon et al., 2011), we used medical records during the one year period prior to breast cancer diagnosis for determining the prevalence of mental illness. The occurrence of mental illness among women with breast cancer may therefore be underreported in this study. Some of the established breast cancer treatment guidelines, including use of chemotherapy for lymph node-positive breast cancer, endocrine therapies for estrogen receptor-positive cancers, and tissue-targeted therapies for Human Epidermal Growth Factor Receptor 2-positive breast cancer, were not considered while determining guideline-consistent breast cancer treatment due to unavailability of information in the MAX files.

This study determined the impact of pre-existing mental illnesses on receipt of guideline-consistent breast cancer treatment and breast cancer-related healthcare utilization using

multistate Medicaid data. Negative association was observed between presence of pre-existing mental illnesses and guideline-consistent breast cancer treatment. The association between pre-existing mental illnesses and breast cancer-related inpatient utilization was found to be statistically insignificant, whereas negative association was observed between pre-existing mental illnesses and breast cancer-related outpatient utilization. The results were found to be consistent across different mental illness categories (any mental disorder, mood disorders, psychotic disorders, substance abuse and dependence disorders, and other mental disorders) for the most part. Negative association was observed between presence of any pre-existing mental illness and breast cancer-related emergency room visits, whereas the results concerning the association between individual mental illness categories and breast cancer-related emergency room visits were statistically non-significant. The results of this study highlight the disparities experienced by newly diagnosed breast cancer patients with pre-existing mental illnesses both in terms of receipt of guideline-consistent breast cancer treatment and breast cancer-related healthcare utilization. Future studies should examine the impact of pre-existing mental illnesses on survival in breast cancer patients.

LIST OF REFERENCES

1) American Cancer Society. What are the key statistics about breast cancer? Available at http://www.cancer.org/Cancer/BreastCancer/DetailedGuide/breast-cancer-key-statistics. Accessed July 17, 2012.
2) American Cancer Society. Breast cancer facts and figures 2013-2014. Available at: http://www.cancer.org/acs/groups/content/@research/documents/document/acspc-040951.pdf. Accessed January 30, 2014.
3) Anderson RT, Kimmick GG, Camacho F, Whitmire JT, Dickinson C, Levine EA, Balkrishnan R. Health system correlates of receipt of radiation therapy after breast-conserving surgery: a study of low-income Medicaid-enrolled women. Am J Manag Care 2008;14:644-652.
4) Baillargeon J, Kuo YF, Lin YL, Raji MA, Singh A, Goodwin JS. Effect of mental disorders on diagnosis, treatment, and survival of older adults with colon cancer. J Am Geriatr Soc 2011;59:1268-1273.
5) Ballard-Barbash R, Potosky AL, Harlan LC, Nayfield SG, Kessler LG. Factors associated with surgical and radiation therapy for early stage breast cancer in older women. J Natl Cancer Inst 1996;88:716-726.
6) Barron JJ, Quimbo R, Nikam PT, Amonkar MM. Assessing the economic burden of breast cancer in a U.S. managed care population. Breast Cancer Res Treat 2008;109:367-377.
7) Bloom BS, de Pouvourville N, Chhatre S, Jayadevappa R, Weinberg D. Breast cancer treatment in clinical practice compared to best evidence and practice guidelines. Br J Cancer 2004;90:26-30.
8) Boyd CA, Benarroch-Gampel J, Sheffield KM, Han Y, Kuo YF, Riall TS. The effect of depression on stage at diagnosis, treatment, and survival in pancreatic adenocarcinoma. Surgery 2012;152:403-413.
9) Burstein HJ, Prestrud AA, Seidenfeld J, Anderson H, Buchholz TA, Davidson NE, Griggs JJ. American Society of Clinical Oncology clinical practice guideline: Update on adjuvant endocrine therapy for women with hormone receptor–positive breast cancer. J Clin Oncol 2010;28:3784-3796.
10) Centers for Medicare and Medicaid Services. Medicaid data sources – general information. Available at http://www.cms.gov/Research-Statistics-Data-and-Systems/Computer-Data-and-Systems/MedicaidDataSourcesGenInfo/index.html?redirect=/MedicaidDataSourcesGenInfo/MSIS/list.asp. Accessed July 25, 2012
11) Centers for Medicare and Medicaid Services. Medicaid analytic extract (MAX) general information. Available at http://www.cms.gov/Research-Statistics-Data-and-Systems/Computer-Data-and-Systems/MedicaidDataSourcesGenInfo/MAXGeneralInformation.html. Accessed July 25, 2012
12) Chadwick A, Street C, McAndrew S, Deacon M. Minding our own bodies: Reviewing the literature regarding the perceptions of service users diagnosed with serious mental illness on barriers to accessing physical health care. Int J Ment Health Nurs 2012;21:211-219.
13) Chagpar AB, McMasters KM, Scoggins CR, Martin RC, Thoene C, Edwards MJ. The use of radiation therapy after breast-conserving surgery in hormonally treated breast

cancer patients is dependent on patient age, geographic region, and surgeon specialty. Am J Surg 2008;195:793.
14) Chien CR, Pan IW, Tsai YW, Tsai T, Liang JA, Buchholz TA, Tina Shih YC. Radiation therapy after breast-conserving surgery: does hospital surgical volume matter? A population-based study in Taiwan. Int J Radiat Oncol Biol Phys 2012;82:43-50.
15) Clarke M, Collins R, Darby S, Davies C, Elphinstone P, Evans E, Wang Y. Effects of radiotherapy and of differences in the extent of surgery for early breast cancer on local recurrence and 15-year survival: an overview of the randomised trials. Lancet 2005;366:2087.
16) Coates AS, Keshaviah A, Thürlimann B et al. Five years of letrozole compared with tamoxifen as initial adjuvant therapy for postmenopausal women with endocrine-responsive early breast cancer: update of study BIG 1-98. J Clin Oncol 2007;25:486-492.
17) Davidson JR, Meltzer-Brody SE. The underrecognition and undertreatment of depression: what is the breadth and depth of the problem? J Clin Psychiatry 1999;60:4-9.
18) D'Hoore W, Bouckaert A, Tilquin C. Practical considerations on the use of the Charlson comorbidity index with administrative data bases. J Clin Epidemiol 1996;49:1429-1433.
19) Druss BG, Bradford DW, Rosenheck RA, Radford MJ, Krumholz HM. Mental disorders and use of cardiovascular procedures after myocardial infarction. JAMA 2000;283:506-511.
20) Fisher B, Anderson S, Bryant J, Margolese RG, Deutsch M, Fisher ER, Wolmark N. Twenty-year follow-up of a randomized trial comparing total mastectomy, lumpectomy, and lumpectomy plus irradiation for the treatment of invasive breast cancer. NEJM 2002;347:1233-1241.
21) Fisher B, Wolmark N, Redmond C, Deutsch M, Fisher ER. Findings from NSABP protocol no. b04: Comparison of radical mastectomy with alternative treatments. II. The clinical and biologic significance of medial-central breast cancers. Cancer 2006;48:1863-1872.
22) Foley KL, Kimmick G, Camacho F, Levine EA, Balkrishnan R, Anderson R. Survival disadvantage among Medicaid-insured breast cancer patients treated with breast conserving surgery without radiation therapy. Breast Cancer Res Treat 2007; 101:207-214.
23) Frayne SM, Halanych JH, Miller DR, Wang F, Lin H, Pogach L, Berlowitz DR. Disparities in diabetes care: impact of mental illness. Arch Intern Med 2005;165:2631-2638.
24) Freedman RA, Virgo KS, He Y, Pavluck AL, Winer EP, Ward EM, Keating NL. The association of race/ethnicity, insurance status, and socioeconomic factors with breast cancer care. Cancer 2011;117:180-189.
25) Goodwin JS, Zhang DD, Ostir GV. Effect of depression on diagnosis, treatment, and survival of older women with breast cancer. J Am Geriatric Soc 2004;52:106-111.
26) Goss PE, Ingle JN, Martino S et al. A randomized trial of letrozole in postmenopausal women after five years of tamoxifen therapy for early-stage breast cancer. N Engl J Med 2003;349:1793-1802.
27) Grilli R, Scorpiglione N, Nicolucci A, Mainini F, Penna A, Mari E, Liberati A. Variation in use of breast surgery and characteristics of hospitals' surgical staff. Int J Qual Health Care 1994;6:233-238.

28) Guadagnoli E, Weeks JC, Shapiro CL, Gurwitz JH, Borbas C, Soumerai SB. Use of breast-conserving surgery for treatment of stage I and stage II breast cancer. J Clin Oncol 1998;16:101-106.
29) Haggstrom DA, Quale C, Smith-Bindman R. Differences in the quality of breast cancer care among vulnerable populations. Cancer 2005;104:2347-2358.
30) Hebert-Croteau N. Brisson J. Latreille J. Rivard M. Abdelaziz N. Martin G. Compliance with consensus recommendations for systemic therapy is associated with improved survival of women with node-negative breast cancer. J Clin Oncol. 2004;22:3685–3693.
31) Howard LM, Barley EA, Davies E, Rigg A, Lempp H, Rose D, Thornicroft G. Cancer diagnosis in people with severe mental illness: practical and ethical issues. Lancet Oncol 2010;11:797-804.
32) Iyengar R, Lund MJ, Lamson P, et al. Using National Quality Forum breast cancer indicators to measure quality of care for patients in an AVON comprehensive breast center. Breast J 2010;16:240-244.
33) Jagsi R, Abrahamse P, Morrow M, Hawley ST, Griggs JJ, Graff JJ, Katz SJ. Patterns and correlates of adjuvant radiotherapy receipt after lumpectomy and after mastectomy for breast cancer. J Clin Oncol 2010:28:2396-2403.
34) Kendrick T. Cardiovascular and respiratory risk factors and symptoms among general practice patients with long-term mental illness. Br J Psychiatry 1996;169:733-739.
35) Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. Arch Gen Psych 2005;62:593-602.
36) Keyzer-Dekker CM, Van Esch L, Schreurs WH, et al. Health care utilization one year following the diagnosis benign breast disease or breast cancer. Breast 2012;21:746-750.
37) Laliberte L, Fennell ML, Papandonatos G. The relationship of membership in research networks to compliance with treatment guidelines for early-stage breast cancer. Med Care 2005;43:471.
38) Landercasper, Dietrich LL, Johnson M. A breast cancer review of compliance with National Comprehensive Cancer Network Breast Cancer guidelines. Am J Surg 2006;192:525-527.
39) Lawrence D, Kisely S. Review: Inequalities in healthcare provision for people with severe mental illness. J Psychopharmacol 2010;24:61-68.
40) Maskarinec G, Pagano I, Lurie G, Bantum E, Gotay CC, Issell BF. Factors affecting survival among women with breast cancer in Hawaii. J Women's Health 2011;20:231-237.
41) Maughan KL, Lutterbie MA, Ham PS. Treatment of breast cancer. Am Fam Physician 2010,81:1339-1346.
42) McGinty EE, Zhang Y, Guallar E, Ford DE, Steinwachs D, Dixon LB, Daumit GL. Cancer Incidence in a Sample of Maryland Residents With Serious Mental Illness. Psychiatr Serv 2012;63:714-717.
43) Mitchell AJ, Malone D, Doebbeling CC. Quality of medical care for people with and without comorbid mental illness and substance misuse: systematic review of comparative studies. Br J Psychiatry 2009;194:491-499.
44) National Comprehensive Cancer Network. Breast cancer: treatment guidelines for patients. Available at: http://screening.iarc.fr/doc/Breast_VIII.pdf. Accessed February 21, 2013.

45) Osborn DP. Topics in review: the poor physical health of people with mental illness. West J Med 2001;175:329.
46) Overgaard M, Hansen PS, Overgaard J, Rose C, Andersson M, Bach F, Zedeler K. Postoperative radiotherapy in high-risk premenopausal women with breast cancer who receive adjuvant chemotherapy. NEJM 1997;337:949-955.
47) Phelan M, Stradins L, Morrison S. Physical health of people with severe mental illness: can be improved if primary care and mental health professionals pay attention to it. BMJ 2001;322:443-444.
48) Ragaz J, Jackson SM, Le N, Plenderleith IH, Spinelli JJ, Basco VE, Olivotto IA. Adjuvant radiotherapy and chemotherapy in node-positive premenopausal women with breast cancer. NEJM 1997;337:956-962.
49) Raji MA, Kuo YF, Freeman JL, et al. Effect of dementia diagnosis on survival of older patients after a diagnosis of breast, colon, or prostate cancer: implications for cancer care. Arch Intern Med 2008;168:2033-2040.
50) Recht A, Edge SB, Solin LJ, Robinson DS, Estabrook A, Fine RE, Pfister DG. Postmastectomy Radiotherapy: Clinical Practice Guidelines of the American Society of Clinical Oncology. J Clin Oncol 2001;19:1539-1569.
51) Reeves WC, Strine TW, Pratt LA et al. Mental illness surveillance among adults in the United States. MMWR Surveill Summ 2011;60:1-29.
52) Research Data Assistance Center. Brief descriptions of MAX files. Available at http://www.resdac.org/Medicaid/file_descriptions.asp. Accessed July 25, 2012.
53) Romond EH, Perez EA, Bryant J et al. Trastuzumab plus adjuvant chemotherapy for operable HER2-positive breast cancer. N Engl J Med 2005;353:1673-1684.
54) Roorda C, Berendsen AJ, Groenhof F, van der Meer K, de Bock GH. Increased primary healthcare utilisation among women with a history of breast cancer. Support Care Cancer 2012. In press.
55) Rosato R, Sacerdote C, Pagano E, Di Cuonzo D, Baldi I, Bordon R, Ciccone G. Appropriateness of early breast cancer management in relation to patient and hospital characteristics: a population based study in Northern Italy. Breast cancer res treat 2009;117:349-356.
56) Russo CA, VanLandeghem K, Davis PH, Elixhauser A. Hospital and Ambulatory Surgery Care for Women's Cancers. HCUP Highlight #2. Rockville, MD: Department of Health and Human Services, Agency for Healthcare Research and Quality. September 2006. AHRQ Pub. No. 06-0038. Satariano ER, Swanson GM, Moll PP. Nonclinical factors associated with surgery received for treatment of early-stage breast cancer. Am J Public Health 1992;82:195-198.
57) Shirvani SM, Pan IW, Buchholz TA, Shih YCT, Hoffman KE, Giordano SH, Smith BD. Impact of evidence-based clinical guidelines on the adoption of postmastectomy radiation in older women. Cancer 2011;117:4595-4605.
58) Smith I, Procter M, Gelber RD et al. HERA study team. 2-year follow-up of trastuzumab after adjuvant chemotherapy in HER2-positive breast cancer: a randomised controlled trial. Lancet 2007;369:29-36.
59) Smith GL, Shih YCT, Xu Y, Giordano SH, Smith BD, Perkins GH, Buchholz TA. Racial disparities in the use of radiotherapy after breast-conserving surgery: A national Medicare study. Cancer 2009;116:734-741.

60) Solin LJ, Legorreta A, Schutz DJ, Levin HA, Zatz S, Goodman RL. Analysis of a claims database for the identification of patients with carcinoma of the breast. J Medical System 1994;18:23-32.
61) Treatment of Early-Stage Breast Cancer. NIH Consens Statement Online 1990;8:1-19
62) United States Department of Agriculture. Rural-urban continuum codes. Available at http://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx. Accessed July 25, 2012.
63) Voti L, Richardson LC, Reis I, Fleming LE, MacKinnon J, Coebergh JW. The effect of race/ethnicity and insurance in the administration of standard therapy for local breast cancer in Florida. Breast Cancer Res Treat 2006;95:89-95.
64) Worthington J, Waterbor JW, Funkhouser E, Falkson C, Cofield S, Fouad M. Receipt of standard breast cancer treatment by African American and White women. Int J Med Sci 2008;5:181-188.
65) Yuen E, Louis D, Cisbani L, et al. Using administrative data to identify and stage breast cancer cases: implications for assessing quality of care. Tumori 2011;97:428-425.

CHAPTER 4

FACTORS ASSOCIATED WITH REPEAT MAMMOGRAPHY SCREENING AMONG WOMEN ENROLLED IN MEDICAID

Introduction

Breast cancer screening enables early detection of breast cancer at an asymptomatic, preventable, and curable stage, and coupled with effective diagnostic procedures and optimal treatment patterns, improves the likelihood of survival (Perry et al., 2008). Mammography screening, which involves imaging of the breast tissue using ionizing radiations such as X-rays, is currently the mainstay of breast cancer screening. Findings from several randomized controlled studies have shown that mammography screening is associated with mortality reduction in the range of 15-25% (Anderson et al., 1988, Bjurstam et al., 1997, Chu et al., 1988, Tabar et al., 1992, Tabar et al., 1995, Roberts et al., 1990). Mammography screening technique has also been found to be cost-effective (Wolstenholme et al., 1998). All leading medical organizations, including the American Cancer Society (ACS), the American College of Radiology (ACR), the American Congress of Obstetricians and Gynecologists (ACOG), the American Medical Association (AMA), the Society of Breast Imaging (SBI), the National Cancer Institute (NCI), and the United States Preventive Services Task Force (USPSTF), recommend mammography screening for women. The USPSTF guidelines recommend biennial mammography screening for women aged

50 to 74 years, whereas the NCI guidelines call for mammograms every 1-2 years in women aged 40 years or more. Other leading medical organizations, including the ACS, the ACR, the AMA, the SBI, and the ACOG, recommend yearly mammograms in all women starting at the age of 40 years.

The national mammography screening rates in the US increased significantly from 30% in 1987 to 70.1% in 2000, post which they declined to 68.1% in 2005 (Breen et al., 2011, Chagpar et al., 2008, Zhou et al., 2010, Shi et al., 2011). The decline in the screening rates has been attributed mainly to the decrease in hormone replacement therapy (HRT) use in the early 2000s owing to a Women's Health Initiative report suggesting an association between long term HRT use and breast cancer (Breen et al., 2007, Wolf et al., 2009). The decreasing trend in the mammography screening rates observed in the first half of the decade of the 2000s has not continued after 2005 (Breen et al., 2011). The recently observed national mammography screening rate of 72.4% in the year 2010 was greater than the 70% goal mentioned in the Healthy people 2010 objectives (Klabunde et al., 2012). Despite these improvements in the mammography screening rates over the years, the rate of regular mammography screening (generally defined as receipt of mammograms every one-two years) continues to be low. It has been reported that less than 50% of the women undergo mammography screening regularly (Clark et al., 2003, Rakowski et al., 2006, Gierisch et al., 2009). Getting routinely screened with mammograms is important for greatest population-level benefits in terms of reduced morbidity and mortality. Previous studies have reported that getting routinely screened with mammograms is associated with earlier detection of breast cancer and improved survival as compared to infrequent or no mammography screening (Freedman et al., 2003, Moss et al., 2006, Hellquist et al., 2010).

An understanding of the factors affecting receipt of routine mammography is a critical first step in order to design strategies aimed at increasing the rates of regular mammography screening. Various socio-demographic, healthcare-related, and psychological factors have been found to be associated with regular mammography screening in the previous studies. Individual characteristics such as Caucasian race (Song et al., 1998, Yood et al., 1999, Sabogral et al., 2001, Strzelczyk and Dignan, 2002), higher education (Strzelczyk and Dignan, 2002, Rahman et al., 2003, Raucher et al., 2005, Litaker et al., 2007), being married (Yood et al., 1999, Coughlin et al., 2004, Borrayo et al., 2009), residence in metropolitan areas (Sabogral et al., 2001), higher income (Phillips et al., 1998, Yood et al., 1999, Sabogral et al., 2001, Rakowski et al, 2006, Litaker et al., 2007), age in the range of 50-59 years (Coughlin et al., 2004, Borrayo et al., 2009, Gierisch et al., 2010), non-indulgence in smoking and indulgence in alcohol (Coughlin et al., 2004, Rosenberg et al., 2005, Rakowski et al., 2006, Borrayo et al., 2009), family history of breast cancer (Lerman et al., 1990, Strzelczyk and Dignan, 2002, Bobo et al., 2004, Rosenberg et al., 2005, Borraryo et al., 2009, Gierisch et al., 2010, Vyas et al., 2012), and possession of health insurance (Cummings et al., 2000, Strzelczyk and Dignan, 2002, Coughlin et al., 2004, Litaker et al., 2007) have been found to be positively associated with routine receipt of breast cancer screening. Factors related to healthcare use such as having a visit to a physician and obstetricians/gynecologists (Taylor et al., 1995, Coughlin et al., 2004, Wu et al., 2007), regular care from a healthcare provider (Bobo et al., 2004, Rakowski et al., 2006, Litaker et al., 2007), use of other preventive procedures such as cervical cancer screening tests, colorectal cancer screening tests, and influenza shots (Phillips et al., 1998, Cummings et al., 2000, Raucher et al., 2005, Rosenberg et al., 2006, Wu et al., 2007), prior mammography or breast biopsy (Song et al., 1998, Bobo et al., 2004), and use of hormone replacement therapy (Bobo et al., 2004, Borrayo et

al., 2009) have been found to be positively impact regular mammography screening. Psychological factors such as perceived susceptibility towards breast cancer, perceived severity of breast cancer, and perceived benefits of mammography screening have also been reported to positively impact routine mammography screening (Lerman et al., 1990, Lee et al., 1995, Taylor et al., 1995, Halabi et al., 2000, Rakowski et al., 2006). Studies have also found factors related to healthcare access such as health maintenance organization (HMO) penetration rate, number of primary care physicians and obstetricians/gynecologists, number of mammography screening facilities, and level of education and income in the area to be positively associated with routine mammography (Phillips et al., 1998, Engelman et al. 2002, Baker et al., 2004, Benjamins et al., 2004, Litaker et al., 2007, Coughlin et al., 2008, Akinyemiju et al., 2012).

Limited information is currently available about the factors associated with regular mammography screening among Medicaid enrollees. Medicaid is a health insurance program that provides medical benefits to certain low-income adults and children, disabled individuals, and pregnant women in the US. The Medicaid program covers nearly 60 million individuals and accounts for 16% of the national health spending (Kaiser Family Foundation [KFF]). Compared to privately insured individuals, Medicaid beneficiaries are more likely to have poor general health status, more physical and mental chronic health conditions, and higher hospitalization and mortality rates (Cunningham et al., 2005, Holohan et al., 2003, KFF). Medicaid enrollees are also likely to have lower access to quality healthcare and fewer family and community resources as compared to other insured individuals (Landon and Epstein, 1999, Piecoro et al., 2001, Rowland, 2005). It has been reported that Medicaid enrollees are less likely to indulge in preventive healthcare services, including mammography screening, as compared to other insured individuals (Schuur et al., 2009, Government Accountability Office).

A few studies have examined the use of regular mammography screening and the associated factors in the Medicaid population (Weir et al., 2011, Bhanegaonkar et al., 2012). Weir et al. (2011) studied the routine mammography use among enrollees of five Medicaid managed care plans in Massachusetts. The authors found that 63% of the women aged 40-64 years received routine mammograms. Various factors, including non-disability, older age, Hispanic race, number of comorbidities, non-indulgence in smoking and alcohol, severe mental illness, no case of domestic violence, lesser number of emergency room (ER) visits, and greater number of office visits during the study period, were found to be positively associated with regular mammography screening. In another study, Bhanegaonkar et al. (2012) examined the mammography screening behaviors of women enrolled in West Virginia Medicaid fee-for-service (FFS) program. It was observed that 8.6% of the women aged 40-64 years demonstrated high persistence with mammography screening (8-10 mammograms during the period 1999-2008). Older age and residence in non-metro rural areas were associated with persistent receipt of mammograms in the bivariate analyses. The authors, however, did not conduct any multivariable analyses to determine the factors associated with mammography screening persistence. Though these studies provide useful information about regular mammography screening among Medicaid enrollees and the associated factors, findings of both these studies may have limited generalizability since they only involved state-specific Medicaid recipients. Further, these studies included only FFS (Bhanegaonkar et al. [2012]) or managed care (Weir et al. [2011]) recipients.

The current study builds on the work of Weir et al. (2011) and Bhanegaonkar et al. (2012) by determining the prevalence of repeat mammography screening and associated factors in a multistate Medicaid population. Effect of individual characteristics including age, race,

number of outpatient visits during the study period, number of ER visits during the study period, use of hormone replacement therapy, and receipt of routine cervical cancer screening tests on repeat mammography screening was determined. In addition, effect of neighborhood factors including those denoting healthcare access in the neighborhood such as number of primary care physicians, number of obstetricians/gynecologists, number of mammography screening facilities, and number of federally qualified healthcare centers per 10,000 women in the county of residence and neighborhood socio-demographic characteristics such as level of urbanization, percentage of population aged 25 or more with at least a high school diploma, and race/ethnicity composition of the county of residence on repeat mammography was studied.

Methods

Data source

The primary source of data for this study was the 2006-2008 Medicaid analytic extract (MAX) files. The MAX files for 39 states (all states except Alaska, Hawaii, Maine, Missouri, Montana, North Dakota, Pennsylvania, South Dakota, Utah, Wisconsin, Wyoming, and District of Columbia) were used for the purpose of the study. MAX files are a set of person-level files developed mainly for the purpose of supporting research and policy analysis. The MAX personal summary, inpatient, other therapy, and prescription drug files were used in this study. Information about demographic characteristics of the recipients including age, race, sex, and location of residence, monthly enrolment status, and medical utilization summaries was available through the MAX personal summary file. Details about medical services received by the recipients in the hospital, ER, or office setting including cost to the recipients, amount reimbursed by Medicaid, service beginning and end date, diagnosis codes based on International

Classification of Diseases, ninth revision, clinical modification (ICD-9-CM), and procedure codes based on Current Procedural Terminology version 4 (CPT-4) or Healthcare Common Procedure Coding System (HCPCS) were made available through the MAX inpatient and other therapy files. The prescription drug usage of the recipients was identified using the National Drug Code (NDC) in the MAX prescription drug file. Identification of individual recipients was not possible in the MAX files in order to protect patient privacy. All the files were linked using an encrypted recipient identification number.

The second source of data used in the study was the Area Resource File (ARF). The 2010-2011 ARF access system, which contains current and historical data, was used for the purpose of this study. The ARF is managed by the United States Health Resources and Services Administration and contains information about health facilities, health professionals, measures of resource scarcity, health status, economic activity, health training programs, and socioeconomic and environmental characteristics for each of the counties in the US. The information in the ARF is obtained from sources such as the Bureau of the Census, the American Hospital Association, the American Medical Association, and the Centers for Disease Control and Prevention. The ARF also contains information about geographic codes including metropolitan-micropolitan statistical area codes, typology codes, Federal Information Processing Standard (FIPS) codes, and economic area codes, based on which it can be linked to other datasets. The ARF and the MAX personal summary file were linked using the FIPS codes. Study protocol was approved by the institutional review board at the University of Mississippi under exempt status.

Study sample

The target population for this study consisted of female Medicaid enrollees who were continuously enrolled in the Medicaid program during 2006-2008 and who were 40 years old or more on January 01, 2006 and less than 65 years old on December 31, 2008. Since mammography screening has been recommended in women aged 40 or more by the ACS, the lower age limit for this study was 40 years. Women aged 65 or more were excluded from the study, since Medicare is the primary payer in these individuals and hence their complete medical records are not available in the MAX files. Women aged less than 65 years, who were enrolled in both Medicare and Medicaid, were also excluded from the study on account of incomplete data in the MAX files. Although annual mammography screening is also recommended after the diagnosis and treatment of breast cancer, the focus of this study was on the use of mammography screening prior to breast cancer diagnosis. Therefore, recipients with a diagnosis of breast cancer (recipients having medical claims with ICD-9-CM diagnosis codes of 174, 233.0, 238.3, or 239.3) during the study period (2006-2008) were excluded from the study.

Measures

Repeat mammography screening was defined as receipt of two successive mammograms with a gap of 10-14 months. Though ACS recommends annual mammograms starting at age 40 until a woman is in good health, a gap of 14 months was allowed between consecutive mammograms in the current study since the recipients can face constraints such as waiting times at the mammography facilities (Gierisch et al., 2010). Moreover, a gap of at least 10 months was required between consecutive mammograms while determining repeat mammography use since mammograms within a span of nine months or less since the previous mammogram are generally follow-up or diagnostic mammograms (Yood et al., 1999, Gierisch et al., 2010). The receipt of

mammography screening was ascertained from the CPT-4 code of 76092 (screening mammography, bilateral) and HCPCS code of G0202 (screening mammography producing direct digital image, bilateral). Repeat mammography screening was determined based on the dates of receipt of mammograms. Apart from a gap of 10-14 months between successive mammograms, an identical gap was required between the start of the study period i.e. January 01, 2006 and the date of the first mammogram during the study period and between date of last mammogram during the study period and end of the study period i.e., December 31, 2008, for classifying recipients as having received repeat mammography. Repeat mammography was considered as a dichotomous variable.

Among the independent variables, age was considered as of January 01, 2006 (beginning of the study period) and was categorized into two groups: 40-49 years and 50-64 years. Race was categorized as white, black, Hispanic or Latino, Asian, Native Hawaiian or other Pacific islander, American Indian or Alaskan Native, and others (consisting of more than one race and unknown race). The number of outpatient visits and number of ER visits during the study period were determined from the 2006-2008 medical services claims data and were considered as continuous variables. Use of hormone replacement therapy (HRT) was determined based on the prescription drug records of the recipients during 2006-2008. Receipt of routine cervical cancer screening tests was defined based on the consensus guidelines from the ACS, the USPSTF, and the ACOG, which recommended Papanicolaou (Pap) test in women aged 30-65 years every 2-3 years at the time of the study period (Jin et al., 2011). Accordingly, the receipt of Pap test at least once during the study period was considered as routine cervical cancer screening. Use of HRT and routine cervical cancer screening were considered as dichotomous variables.

In terms of neighborhood factors, level of urbanization of the counties was considered as a categorical variable and consisted of three categories: metropolitan, suburban, or rural. The definition of level of urbanization was based on the United States Department of Agriculture (USDA) rural-urban continuum codes: metropolitan location (codes 0-3), suburban location (codes 4-5), and rural location (codes 6-9). The rural-urban continuum codes were determined from the Federal Information Processing Standard (FIPS) code for the county of residence listed in the 2006 MAX personal summary file. Other neighborhood factors, including number of primary care physicians, number of obstetricians/gynecologists, number of mammography screening facilities, and number of federally qualified healthcare centers per 10,000 women, percentage of the county population aged 25 or more with at least a high school diploma, percentage of the county population Hispanic, and percentage of the county population non-Hispanic black (the latter two denoting the race/ethnicity composition of each county), were categorized into quartiles for the purpose of this study. Information about the neighborhood factors was gathered from the 2010-2011 ARF access system. Information concerning number of federally qualified healthcare centers, number of primary care physicians, and number of obstetricians/gynecologists and neighborhood demographic characteristics, including percentage of the county population aged 25 or more with at least a high school diploma, percentage of the county population Hispanic, and percentage of the county population non-Hispanic black was from the year 2006. The latest available data (1994) was used in case of county-level mammography screening facilities.

Statistical Analysis

Descriptive statistics were conducted to determine the characteristics of the study sample. Means and standard deviations were reported for continuous variables, whereas frequencies and percentages were reported for categorical variables. In the context of the current study, recipients were nested within counties and counties were nested within states. Hence, in order to take into account correlation within clusters as well as examine the effects of individual and neighborhood characteristics on repeat mammography screening, hierarchical logistic regression, a multilevel modeling procedure, was used in the study. Bivariate analyses were conducted using unadjusted hierarchical logistic regression models with county and state as random effects. In order to determine the factors affecting repeat mammography screening, multivariable hierarchical logistic regression models were fitted with all the predictors as fixed effects and county and state as random effects. Type of reimbursement system (categorized as FFS only [recipients who were enrolled in FFS Medicaid during 2006-2008] and managed care [recipients who were enrolled in Medicaid managed care for at least one month during 2006-2008]) was also included as a covariate in the multivariable logistic regression models. Odds ratios and 95% confidence intervals were reported for the results of the hierarchical logistic regression analyses. Level of statistical significance (α) was considered to be 0.05. All analyses were performed using Statistical Analysis System (SAS) version 9.2 (SAS Institute Inc., Cary, NC). The SAS procedure PROC GLIMMIX was used for fitting the hierarchical logistic regression models.

Results

The study sample consisted of 1,029,836 women. Table 4.1 presents the demographic, healthcare-related, and neighborhood characteristics of the study sample. More than half of the study sample (53.60%) was 40-49 years of age. Nearly 42% of the sample was white, 25% was

black, and the remaining 33% were ethnic minorities such as Hispanics/Latinos, Asians, Native Hawaiian or other Pacific Islanders, and American Indians or Alaskan natives. Roughly 1.19% of the population received repeat mammograms in accordance with established guidelines during the study period. In terms of other healthcare-related characteristics, nearly 12% of the population received hormone replacement therapy. Approximately 9% of the recipients underwent cervical cancer screening in accordance with established guidelines (at least one Pap test during the study period). The average number of visits to outpatient centers during the study period was 31.42(±37.04) whereas the average number visits to emergency rooms was 3.61(±8.15). Majority of the sample (82.83%) resided in metropolitan counties. The study recipients were uniformly distributed across quartiles of the other neighborhood measures including number of primary care physicians in the county per 100,000 women, number of obstetricians/gynecologists in the county per 100,000 women, number of federally qualified health centers per 100,000 women, number of mammography screening facilities per 100,000 women, percentage of county population Hispanic, percentage of county population non-Hispanic black, and percentage of county population with at least a high school diploma.

Table 4.1. Study sample characteristics

Characteristics	N (%)
Personal characteristics	
Age (years)	
40-49	551,949 (53.60)
50-64	477,887 (46.40)
Race	
White	428,573 (41.62)
Black	258,527 (25.10)
Hispanic or Latino	118,990 (11.55)
Asian	51,853 (5.04)
Native Hawaiian or other Pacific islander	18,413 (1.79)
American Indian or Alaskan native	11,045 (1.07)

Others	142,435 (13.83)
Repeat mammography screening	
Yes	12,212 (1.19)
No	10,17,624 (98.81)
Hormone replacement therapy	
Yes	118,892 (11.54)
No	910,944 (88.46)
Routine cervical cancer screening	
Yes	95,845 (9.31)
No	933,991 (90.69)
Number of outpatient visits during the study period, Mean (SD)	31.42 (37.04)
Number of emergency room visits during the study period	3.61 (8.15)
Neighborhood characteristics	
Number of primary care physicians per 100,000 female population in the county	
1st quartile (poorest)	257,602 (25.01)
2nd quartile	250,261 (24.30)
3rd quartile	256,881 (24.94)
4th quartile	265,092 (25.74)
Number of obstetricians/gynecologists per 100,000 female population in the county	
1st quartile (poorest)	248,024 (24.08)
2nd quartile	253,329 (24.60)
3rd quartile	271,058 (26.32)
4th quartile	257,425 (25.00)
Number of mammography screening facilities per 100,000 female population in the county	
1st quartile (poorest)	271,623 (26.34)
2nd quartile	243,044 (23.60)
3rd quartile	265,625 (25.79)
4th quartile	249,904 (24.27)
Number of federally qualified health centers per 100,000 female population in the county	
1st quartile (poorest)	250,253 (24.30)
2nd quartile	265,543 (25.49)
3rd quartile	258,536 (25.10)
4th quartile	258,504 (25.10)
Level of urbanization in the county	
Metropolitan	853,027 (82.83)
Suburban	67,031 (6.51)
Rural	109,778 (10.66)
Percentage of county population Hispanic	
1st quartile	257,691 (25.02)

2nd quartile	257,665 (25.02)
3rd quartile	256,511 (24.91)
4th quartile (poorest)	257,969 (25.05)
Percentage of county population non-Hispanic black	
1st quartile	257,447 (25.00)
2nd quartile	258,340 (25.09)
3rd quartile	256,376 (24.93)
4th quartile (poorest)	257,313 (24.99)
Percentage of county population with at least a high school diploma	
1st quartile (poorest)	257,073 (24.96)
2nd quartile	238,245 (23.23)
3rd quartile	276,053 (26.81)
4th quartile	257,465 (25.00)
Total	**10,29,836 (100)**

SD: standard deviation

Table 4.2 presents the results of the hierarchical logistic regression analyses conducted to determine the predictors of repeat mammography screening in the Medicaid population. In the multivariable models, recipients aged 40-49 years were found to be less likely to receive repeat mammograms during the study period as compared to those aged 50-64 years (adjusted odds ratio [AOR] = 0.708, 95% confidence interval [CI] = 0.681 – 0.735). Ethnic minorities including Hispanics/Latinos (AOR = 1.200, 95% CI = 1.119 – 1.288), Asians (AOR = 1.345, 95% CI = 1.237 – 1.462), Native Hawaiian/ other Pacific islanders (AOR = 1.412, 95% CI = 1.232 – 1.618), and others (AOR = 1.149, 95% CI = 1.083 – 1.219) were more likely than whites to receive repeat mammography screening. American Indians/ Alaskan natives (AOR = 0.679, 95% CI = 0.540 – 0.854) were less likely to undergo repeat mammography screening as compared to whites. No statistically significant difference was observed in the odds of receiving repeat mammograms between blacks and whites (AOR = 1.015, 95% CI = 0.960 – 1.073). The estimated odds of receiving repeat mammograms were lower in recipients who did not receive

hormone replacement therapy (AOR = 0.646, 95% CI = 0.615 – 0.678) and routine cervical cancer screening (AOR = 0.580, 95% CI = 0.550 – 0.613) during the study period as compared to those who received hormone replacement therapy and routine cervical cancer screening during the study period respectively. Number of outpatient visits during the study period (AOR = 1.005, 95% CI = 1.005 – 1.005) were positively associated, whereas number of emergency room visits during the study period (AOR = 0.978, 95% CI = 0.975 – 0.981) were negatively associated with receipt of repeat mammography screening. In terms of association between neighborhood characteristics and repeat mammography screening, number of primary care physicians in the county per 100,000 women and number of federally qualified health centers in the county per 100,000 women emerged as the significant predictors. Recipients residing in counties ranked lowest in terms of number of primary care physicians per 100,000 female population (1^{st} quartile) were more likely to receive repeat mammography screening as compared to those residing in counties ranked highest in terms number of primary care physicians per 100,000 female population (4^{th} quartile) (AOR = 1.219, 95% CI = 1.013 – 1.468). Recipients residing in counties ranked lowest in terms of number of federally qualified health centers per 100,000 women were less likely to receive repeat mammography screening as compared to those residing in counties ranked highest in terms of number of federally qualified health centers per 100,000 women (AOR = 0.900, 95% CI = 0.828 – 0.977).

Table 4.2. Hierarchical logistic regression analysis for determining factors affecting repeat mammography screening

Characteristics	Odds ratio (95% confidence interval)	
	Unadjusted	**Adjusted**
Personal characteristics		
Age (years)		
40-49	0.860 (0.803 – 0.922)	0.708 (0.681 – 0.735)

50-64	Reference	Reference
Race		
Black	0.935 (0.886 – 0.986)	1.015 (0.960 – 1.073)
Hispanic or Latino	1.123 (1.048 – 1.203)	1.200 (1.119 – 1.288)
Asian	1.398 (1.288 – 1.519)	1.345 (1.237 – 1.462)
Native Hawaiian or other Pacific islander	1.484 (1.296 – 1.699)	1.412 (1.232 – 1.618)
American Indian or Alaskan native	0.609 (0.484 – 0.768)	0.679 (0.540 – 0.854)
Others	1.137 (1.072 – 1.206)	1.149 (1.083 – 1.219)
White	Reference	Reference
Number of outpatient visits during the study period, Mean (SD)	1.004 (1.004 – 1.005)	1.005 (1.005 – 1.005)
Number of emergency room visits during the study period	0.989 (0.986 – 0.992)	0.978 (0.975 – 0.981)
Hormone replacement therapy		
No	0.577 (0.549 – 0.605)	0.646 (0.615 – 0.678)
Yes	Reference	Reference
Routine cervical cancer screening		
No	0.562 (0.533 – 0.593)	0.580 (0.550 – 0.613)
Yes	Reference	Reference
Neighborhood characteristics		
Number of primary care physicians per 100,000 female population in the county		
1st quartile (poorest)	1.149 (1.001 – 1.320)	1.219 (1.013 – 1.468)
2nd quartile	1.138 (0.988 – 1.310)	1.164 (0.982 – 1.381)
3rd quartile	1.177 (1.013 – 1.366)	1.172 (0.999 – 1.375)
4th quartile	Reference	Reference
Number of obstetricians/gynecologists per 100,000 female population in the county		
1st quartile (poorest)	1.027 (0.916 – 1.152)	0.923 (0.788 – 1.081)
2nd quartile	1.077 (0.952 – 1.218)	0.985 (0.847 – 1.146)
3rd quartile	1.086 (0.953 – 1.238)	1.031 (0.897 – 1.185)
4th quartile	Reference	Reference
Number of mammography screening facilities per 100,000 female population in the county		
1st quartile (poorest)	0.936 (0.855 – 1.024)	0.938 (0.853 – 1.031)
2nd quartile	0.899 (0.803 – 1.007)	0.910 (0.810 – 1.023)
3rd quartile	0.954 (0.875 – 1.040)	0.961 (0.880 – 1.050)
4th quartile	Reference	Reference

Number of federally qualified health centers per 100,000 female population in the county		
1st quartile (poorest)	0.910 (0.839 – 0.986)	0.900 (0.828 – 0.977)
2nd quartile	0.974 (0.872 – 1.089)	1.005 (0.892 – 1.132)
3rd quartile	0.934 (0.828 – 1.054)	0.936 (0.827 – 1.059)
4th quartile	Reference	Reference
Level of urbanization in the county		
Metropolitan	0.987 (0.909 – 1.071)	0.999 (0.903 – 1.107)
Suburban	1.066 (0.954 – 1.191)	1.069 (0.952 – 1.201)
Rural	Reference	
Percentage of county population Hispanic		
1st quartile	0.985 (0.839 – 1.157)	1.087 (0.910 – 1.297)
2nd quartile	0.892 (0.770 – 1.033)	0.979 (0.831 – 1.152)
3rd quartile	0.866 (0.741 – 1.011)	0.938 (0.796 – 1.105)
4th quartile (poorest)	Reference	Reference
Percentage of county population non-Hispanic black		
1st quartile	1.072 (0.960 – 1.197)	1.052 (0.933 – 1.187)
2nd quartile	0.977 (0.872 – 1.095)	0.969 (0.862 – 1.088)
3rd quartile	0.898 (0.786 – 1.026)	0.906 (0.792 – 1.037)
4th quartile (poorest)	Reference	Reference
Percentage of county population with at least a high school diploma		
1st quartile (poorest)	1.010 (0.911 – 1.121)	0.942 (0.828 – 1.072)
2nd quartile	1.038 (0.944 – 1.141)	1.012 (0.912 – 1.123)
3rd quartile	1.035 (0.920 – 1.166)	1.040 (0.924 – 1.171)
4th quartile	Reference	Reference

Discussion

Routine mammography screening has been associated with early breast cancer detection and improved survival. Guidelines from major medical organizations recommend annual mammograms in women aged 40 years or more. However, it has been reported that more than half of the eligible women in the US do not undergo mammography screening regularly.

Knowledge about factors affecting routine mammography screening is crucial for devising strategies to increase regular mammography screening rates. The current study contributes to the literature concerning factors affecting routine mammography screening by determining the factors affecting repeat mammography screening among Medicaid enrollees. The impact of various recipient and neighborhood characteristics on repeat mammography screening was determined. To the best of our knowledge, this is the first study to determine prevalence of routine mammography screening and the associated factors in the national Medicaid population.

Only 1.19% of the study sample received repeat mammograms as per the recommended guidelines during the study period. Our estimate of routine mammography screening rate is lower than the rates reported in previous studies examining routine mammography screening in the Medicaid population (Weir et al., 2011, Bhanegaonkar et al., 2012). In their study of mammography use in beneficiaries of five Medicaid managed care plans in Massachusetts, Weir et al. (2011) found 63% of women aged 40-64 years to have received routine mammograms (at least one mammogram during the study period of 2005-2006). Bhanegaonkar et al. (2012) studied mammography screening practices of women enrolled in West Virginia FFS Medicaid program and found 8.6% of the women aged 40-64 years to have received routine mammograms (8-10 mammograms during the period 1999-2008). The differences in our findings and those of Weir et al. (2011) and Bhanegaonkar et al. (2012) could be attributed to differences in study settings and also the definition of routine mammography screening. When we made our routine mammography screening criteria similar to that of Weir et al. (2011), who defined routine mammography as once every two years, the routine mammography screening rate increased to 36.89% in 2006-2007 and 38.63% in 2007-2008. Though higher than the 1.19% repeat mammogram rate observed with the original criteria used in the study (one mammogram every

10-14 months), the rate for screening with the new criteria (one mammogram every two years) still falls short of the rate reported by Weir et al. (2011). Considering that major national organizations recommend mammography once every year, the original criteria used in our study falls in line with these recommendations, and therefore should be considered for policy implications. The strikingly low rate of routine mammography screening obtained in this study highlights the urgent need of interventions aimed at increasing the use of mammography screening among women enrolled in Medicaid.

Interesting results emerged from the multivariable analyses conducted to determine factors associated with repeat mammography screening. Women in the age group 40-49 years were less likely to receive repeat mammography screening as compared to those in the age group 50-64 years. A likely reason for this finding could be the inconsistency in the mammography screening guidelines for women aged 40-49 years. At the time of the study period, ACS, ACR, and ACOG recommended annual mammography screening whereas NCI and USPSTF recommended screening every 1-2 years in women aged 40-49 years (Feig, 2005). On the other hand, annual mammography screening was universally recommended by all the major organizations for women aged 50 years or more at the time of the study period (Feig, 2005). In the recent times, increasing evidence has accrued supporting the use of annual mammography screening in women aged 40-49 years (Gierisch ete al., 2009, Hellquist et al., 2010). Currently, most of the major medical organizations recommend annual mammography screening in women beginning at age 40. Ethnic minorities including Hispanic or Latino, Asian, and Native Hawaiian or other Pacific Islander had higher odds of receiving repeat mammography screening as compared to whites. Other studies involving Medicaid enrollees have reported similar results (Dubard et al., 2009, Weir et al., 2011). In their study involving enrollees of the Massachusetts

Medicaid managed care system, Weir et al. (2011) found that Hispanics and others (American Indians, Asian/Pacific Islanders, and other race) were 40% and 61%, more likely, respectively, to receive routine mammography screening as compared to whites. It is possible that factors such as cultural influences and beliefs about preventive healthcare among minority women contribute towards their higher mammography screening rate.

Number of outpatient visits during the study period was positively associated with the receipt of repeat mammography screening. Similar results were reported by Barr et al. (2001) in their study involving women enrolled in a New York health maintenance organization. In their study, women with 1-5 visits and 6 or more visits to primary care physicians during the study period of 2 years were 3.20 times and 4.30 times, more likely, respectively to receive regular mammography screening as compared to those with no visits. The likely reason for the positive association between number of outpatient visits and repeat mammography screening observed in our study could be the increased likelihood of receiving a recommendation for mammography screening, one of the most influential factors affecting mammography screening, during outpatient visits (Miller et al., 2012). Further, it is likely that regular exposure to mammography screening promotional campaigns, which are highly prevalent in physician offices and outpatient centers, positively affects the mammography screening behaviors of the patients. Number of emergency room visits during the study period was negatively associated with receipt of repeat mammography screening. The use of emergency rooms is generally indicative of individual's tendency not to seek routine care, which is likely to be translated to poor preventive health behaviors. Considering the higher routine mammography screening rates among recipients with regular healthcare use, interventions aimed at increasing the regular use of mammography screening should be targeted towards recipients who do not routinely seek healthcare.

Interventions such as mailed brochures emphasizing the susceptibility of these individuals towards breast cancer, health consequences of breast cancer, and benefits of routine mammography screening could be used to promote regular mammography screening.

A positive association was observed between hormone replacement therapy and repeat mammography screening. Similar finding has been observed in previous studies (Bobo et al., 2004, Rahman et al., 2004). The likely reason for higher rates of repeat mammography screening observed among women on hormone replacement therapy could be the elevated risk of breast cancer among women receiving hormone replacement therapy as established in the highly publicized Women's Health Initiative trial in 2002 (Rossouw et al., 2002, Chlebowski et al., 2009). Consistent with the prior literature, receipt of routine mammography screening was found to be positively associated with routine cervical cancer screening. While it could not be ascertained in our study on account of limitations in the data, other studies have found that other preventive health behaviors including colorectal cancer screening tests, influenza shots, cholesterol tests, blood glucose exams, and gynecologic exams positively impact regular mammography screening (Phillips et al., 1998, Cummings et al., 2000, Rauscher et al. 2005, Rosenberg et al., 2005, Wu et al., 2007). These findings suggest the role played by preventive health behaviors in breast cancer screening. Healthcare providers should recommend and reiterate the importance of routine mammography screening while women seek other preventive health behaviors. In terms of association between neighborhood factors and repeat mammography screening, we observed statistically insignificant results for the most part.

Few limitations in our study need to be addressed. Administrative claims data can be subject to coding errors, which can affect the study results. Beneficiaries enrolled in both Medicare and Medicaid were excluded from the study since complete information about their

healthcare utilization was not available in MAX files. Hence the results of this study are not representative of the entire Medicaid population in the US. Information about free or unbilled mammograms provided by clinics, hospitals, or healthcare programs was not available in the MAX files, which might have led to underestimation of the actual screening rates in the Medicaid population. Psychological factors affecting use of mammography such as perceived risk and severity of breast cancer, and views about benefits of mammography and other factors such as recommendation from a physician and family history of breast cancer were not included in the study due to lack of information in the MAX files. The Area Resource File data for the number of mammography screening facilities per 10,000 women in the county do not correspond to the study period. The results of this study should be interpreted taking these limitations into consideration.

The current study determined the prevalence of repeat mammography screening and the associated factors in the Medicaid population. Only ~1.2% of the women aged 40-64 years received repeat mammograms during the study period in accordance with the established guidelines. The repeat mammography screening rates were higher in women aged 50-64 years and those belonging to ethnic minorities as compared to women aged 40-49 years and whites respectively. Number of outpatient visits during the study period was positively associated, whereas number of emergency room visits during the study period was negatively associated with receipt of repeat mammography screening. Use of hormone replacement therapy and routine cervical cancer screening were positively associated with repeat mammography screening. The results for the association between neighborhood healthcare access-related and sociodemographic variables and receipt of repeat mammography screening were statistically insignificant for the most part. Policy makers could use the study findings to design

interventions aimed at increasing the routine mammography screening rates in the Medicaid population.

LIST OF REFERENCES

1) Akinyemiju TF, Soliman AS, Yassine M, Banerjee M, Schwartz K, Merajver S. Healthcare access and mammography screening in Michigan: a multilevel cross-sectional study. Int J Equity Health 2012;11:16.
2) American Cancer Society. American Cancer Society guidelines for the early detection of cancer. Available at http://www.cancer.org/Healthy/FindCancerEarly/CancerScreeningGuidelines/american-cancer-society-guidelines-for-the-early-detection-of-cancer. Accessed July 16, 2012.
3) American Medical Association. Support given to mammography access for women older than 40. Available at http://www.ama-assn.org/amednews/m/2012/07/02/psg0702.htm. Accessed July 22, 2012.
4) Andersson I, Aspegren K, Janzon L, et al. Mammographic screening and mortality from breast cancer: the Malmo mammographic screening trial. BMJ 1988;297:943-948.
5) Baker LC, Phillips KA, Haas JS, Liang SY, Sonneborn D. The effect of area HMO market share on cancer screening. Health Serv Res 2004;39:1751-1772.
6) Benjamins MR, Kirby JB, Bond Huie SA. County characteristics and racial and ethnic disparities in the use of preventive services. Prev Med 2004;39:704-712.
7) Bhanegaonkar A, Madhavan SS, Khanna R, Remick RC. Declining mammography screening in a state Medicaid fee-for-service program: 1999-2008. J Womens Health 2012;21:821-829.
8) Bjurstam N, Bjorneld L, Duffy SW, et al. The Gothenburg breast screening trial: first results on mortality, incidence, and mode of detection for women ages 39–49 years at randomization. Cancer 1997;80:2091-2099.
9) Borrayo EA, Hines L, Byers T, et al. Characteristics associated with mammography screening among both Hispanic and non-Hispanic White women. J Women's Health 2009;18:1585-1594.
10) Breen N, A Cronin K, Meissner HI, et al. Reported drop in mammography. Cancer 2007;109:2405-2409.
11) Breen N, Gentleman JF, Schiller JS. Update on mammography trends: comparisons of rates in 2000, 2005, and 2008. Cancer 2011;117:2209-2218.
12) Centers for Medicare and Medicaid Services. Medicaid data sources – general information. Available at http://www.cms.gov/Research-Statistics-Data-and-Systems/Computer-Data-and-Systems/MedicaidDataSourcesGenInfo/index.html?redirect=/MedicaidDataSourcesGenInfo/MSIS/list.asp. Accessed July 25, 2012
13) Centers for Medicare and Medicaid Services. Medicaid analytic extract (MAX) general information. Available at http://www.cms.gov/Research-Statistics-Data-and-Systems/Computer-Data-and-Systems/MedicaidDataSourcesGenInfo/MAXGeneralInformation.html. Accessed July 25, 2012
14) Chagpar AB, Polk HC, McMasters KM. Racial trends in mammography rates: a population-based study. Surgery 2008;144:467-472.
15) Chlebowski RT, Hendrix SL, Langer RD, et al. Influence of estrogen plus progestin on breast cancer and mammography in healthy postmenopausal women: the Women's Health Initiative Randomized Trial. JAMA 2003;289:3243-3253.
16) Chu KC, Smart CR, Tarone RE. Analysis of breast cancer mortality and stage distribution for the Health Insurance Plan clinical trial. J Natl Cancer Inst 1988;80:1125-1132.

17) Clark MA, Rakowski W, Bonacore LB. Repeat mammography: prevalence estimates and considerations for assessment. Ann Behav Med 2003;26:201-211.
18) Coughlin SS, Uhler RJ, Hall HI, Briss PA. Nonadherence to breast and cervical cancer screening: What are the linkages to chronic disease risk? Prev Chronic Dis 2004;1:A04.
19) Cummings DM, Whetstone 1, ShendeA, et al. Predictors of screening mammography: implications for office practice. Arch Fam Med 2000;9:870-875.
20) Cunningham PJ. Medicaid Cost Containment and Access to Prescription Drugs. Health Affairs (Millwood) 2005;24:780-789.
21) DuBard CA, Yow A, Bostrom S, Attiah E, Griffith B, Lawrence W. Racial/ethnic differences in quality of care for North Carolina Medicaid recipients. N C Med J 2009;70:96-101.
22) Engelman KK, Hawley DB, Gazaway R, Mosier MC, Ahluwalia JS, Ellerbeck EF. Impact of geographic barriers on the utilization of mammograms by older rural women. J Am Geriatr Soc 2002;50:62-68.
23) Feig SA. Screening mammography controversies: resolved, partly resolved, and unresolved. *Breast* J 2005;11(s1):S3-S6.
24) Freedman GM, Anderson PR, Goldstein LJ et al. Routine mammography is associated with earlier stage disease and greater eligibility for breast conservation in breast carcinoma patients age 40 years and older. Cancer 2003;98:918-925.Gierisch JM, O'Neill SC, Rimer BK, DeFrank JT, Bowling JM, Skinner CS. Factors associated with annual-interval mammography for women in their 40s. Cancer Epidemiol 2009;33:72-78.
25) Gierisch JM EJ, Brewer NT, Rimer BK,. Longitudinal predictors of nonadherence to maintenance of mammography. Cancer Epidemiol Biomarkers Prev 2010;19:1103-1111.
26) Government Accountability Office. Medicaid preventive services: concerted efforts needed to ensure beneficiaries receive services. Available at http://www.gao.gov/new.items/d09578.pdf. Accessed January 10, 2013.
27) Halabi S, Skinner CS, Samsa GP, Strigo TS, Crawford YS, Rimer BK. Factors associated with repeat mammography screening. J Fam Pract 2000;49:1104-1112.
28) Hellquist BN, Duffy SW, Abdsaleh S, et al. Effectiveness of population- based service screening with mammography for women ages 40 to 49 years. Cancer 2011;117:714-722.
29) Holohan J, Weil A, Wiener J, eds. Federalism and health policy. Washington, DC: Urban Institute Press, 2003.
30) Jin XW, Sikon A, Yen-Lieberman B Cervical cancer screening: Less testing, smarter testing. Cleve Clin J Med 2011;78:737-747.
31) Kaiser Family Foundation. Medicaid as a platform for broader health reform: supporting high-need and low-income populations. Available at http://www.kff.org/medicaid/upload/7898.pdf. Accessed July 20, 2012.
32) Klabunde C, Brown M, Ballard-Barbash R, et al. Cancer Screening—United States, 2010. MMWR Morb Mortal Wkly Rep 2012;61:41-45.
33) Lee J, Vogel V. Who Uses Screening Mammography Regularly? Cancer Epidemiol Biomarkers Prev 1995;4:901-906.
34) Lee CH, Dershaw DD, Kopans D et al. Breast cancer screening with imaging: Recommendations from the society of breast imaging and the ACR on the use of mammography, breast MRI, breast ultrasound, and other technologies for the detection of clinically occult breast cancer. J Am Coll Radiol 2010;7:18-27.

35) Lerman C, Rimer B, Trock B, Balshem A, Engstrom P. Factors associated with repeat adherence to breast cancer screening. Prev Med 1990;19:279-290.Litaker D, Tomolo A. Association of contextual factors and breast cancer screening: Finding new targets to promote early detection. J Womens Health 2007;16:36-45.
36) Moss SM, Cuckle H, Evans A, Johns L, Waller M, Bobrow L. Effect of mammographic screening from age 40 years on breast cancer mortality at 10 years' follow-up: a randomised controlled trial. Lancet 2006;368:2053-2060.
37) Miller JW, King JB, Joseph DA, Richardson LC. Breast cancer screening among adult women—behavioral risk factor surveillance system, United States, 2010. MMWR Morb Mortal Wkly Rep 2012;*61*(Suppl):46-50.
38) National Cancer Institute. Breast cancer treatment. Available at http://www.cancer.gov/cancertopics/pdq/treatment/breast/Patient/page5. Accessed July 20, 2012.
39) Perry N, Broeders M, de Wolf C, Tornberg S, Holland R, von Karsa L. European guidelines for quality assurance in breast cancer screening and diagnosis. Fourth edition--summary document. Ann Oncol 2008;19:614-622.
40) Phillips KA, Kerlikowske K, Baker LC, et al. Factors associated with women's adherence to mammography screening guidelines. Health Serv Res 1998;33:29-53.
41) Piecoro LT, Potoski M, Talbert JC, Doherty DE. Asthma prevalence, cost, and adherence with expert guidelines on the utilization of health care services and costs in a state Medicaid population. Health Serv Res 2001;36:357-371.
42) Rahman SM, Dignan MB, Shelton BJ. Factors influencing adherence to guidelines for screening mammography among women aged 40 years and older. Ethn Dis 2003;13:477-484.
43) Rakowski W. Meissner H. Vernon SW, et al. Correlates of repeat and recent mammography for women ages 45 to 75 in the 2002 to 2003 Health Information National Trends Survey (HINTS 2003)Cancer Epidemiol Biomarkers Prev 2006;15:2093.
44) Raucher GH, Tropman Hawley S, Earp JL. Baseline predictors of initiation vs. maintenance of regular mammography use among rural women. Prev Med 2005;40:822-830.
45) Research Data Assistance Center. Brief descriptions of MAX files. Available at http://www.resdac.org/Medicaid/file_descriptions.asp. Accessed July 25, 2012.
46) Roberts MM, Alexander FE, Anderson TJ, et al. Edinburgh trial of screening for breast cancer: mortality at seven years. Lancet 1990;335:241-246.
47) Rosenberg L, Wise LA, Palmer JR, Horton NJ, Adams-Campbell LL. A multilevel study of socioeconomic predictors of regular mammography use among African-American women. Cancer Epidemiol Biomarkers Prev 2005;14:2628-2633.
48) Rossouw JE, Anderson GL, Prentice RL, LaCroix AZ, Kooperberg C, Stefanick ML, Ockene J. Writing Group for the Women's Health Initiative Investigators. Risks and benefits of estrogen plus progestin in healthy postmenopausal women: principal results from the Women's Health Initiative randomized controlled trial. JAMA 2002;288:321-333.
49) Rowland D. Medicaid at Forty. Health Care Financ Rev 2005-2006;27:2:63-77.
50) Sabogal F, Merrill SS, Packel L. Mammography rescreening among older California women. Health Care Financ Rev 2001;22:63–75.

51) Schuur JD, Shah A, Wu Z, Forman HP, Gross CP. The impact of Medicaid coverage and reimbursement on access to diagnostic mammography. Cancer 2009;115:5566-5578.
52) Slomiany BA, McMasters KM, Chagpar AB. The recent decline in mammography rates is limited to low- to average-risk women. Am J Surg 2008;196:821-826.
53) Song L, Fletcher R. Breast cancer rescreening in low-income women. Am J Prev Med 1998;15:128-33.
54) Strzelczyk JJ, Dignan MB. Disparities in adherence to recommended followup on screening mammogram: interaction of sociodemographic factors. Ethn Dis 2002;12:77–86.
55) Tabar L, Fagerberg G, Duffy SW, et al. Update of the Swedish two-county program of mammographic screening for breast cancer. Radiol Clin North Am 1992;30:187-210.
56) Tabar L, Fagerberg G, Chen HH, et al. Efficacy of breast cancer screening by age: new results from the Swedish Two-county Trial. Cancer 1995;75:2507-2517.
57) Taylor, V. M., Taplin, S. H., Urban, N., White, E., and Peacock, S. Repeat mammography use among women ages 50–75. Cancer Epidemiol Biomark Prev 1995;4:409-413.
58) The American Congress of Obstetricians and Gynecologists. Annual mammograms now recommended for women beginning at age 40. Available at http://www.acog.org/About_ACOG/News_Room/News_Releases/2011/Annual_Mammograms_Now_Recommended_for_Women_Beginning_at_Age_40. Accessed July 22, 2012.
59) United States Department of Agriculture. Rural-urban continuum codes. Available at http://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx. Accessed July 25, 2012.
60) U.S. Department of Health and Human Services. Area resource file: overview. Available at http://arf.hrsa.gov/overview.htm. Accessed January 11, 2013.
61) U.S. Preventive Services Task Force. Screening for breast cancer: recommendation statement. Available at http://www.uspreventiveservicestaskforce.org/uspstf09/breastcancer/brcanrs.htm. Accessed July 22, 2012.
62) Vyas A, Madhavan S, Lemasters T, Atkins E, Gainor S, Kennedy S, et al. Factors influencing adherence to mammography screening guidelines in appalachian women participating in a mobile mammography program. J Community Health 2012;37:632-646.
63) Weir S, Posner HE, Jones WC, Willis G, Baxter JD, Clark RE. Disparities in routine breast cancer screening for Medicaid managed care members with a work-limiting disability. Medicare Medicaid Res Rev 2011;1.
64) Wolf AB, Brem RF. Decreased mammography utilization in the United States: why and how can we reverse the trend? AJR Am J Roentgenol 2009;192:400-402.
65) Wolstenholme JL, Smith SJ, Whynes DK. The costs of treating breast cancer in the United Kingdom: implications for screening. Int J Technol Assess Health Care. 1998;14:277-289.
66) Wu H, Zhu K, Jatoi I, Shah M, Shriver CD, Potter J. Factors associated with the incompliance with mammogram screening among individuals with a family history of breast cancer or ovarian cancer. Breast Cancer Res Treat 2007;101:317-324.

67) Yood MU, McCarthy BD, Lee NC, Jacobsen G, Johnson CC. Patterns and characteristics of repeat mammography among women 50 years and older. Cancer Epidemiol Biomarkers Prev 1999;8:595-99.
68) Zhou J, Enewold L, Peoples GE, et al. Trends in cancer screening among Hispanic and White non-Hispanic women, 2000-2005. J Women's Health. 2010;19:2167-2174.

CHAPTER 5

SUMMARY AND CONCLUSIONS

Study Summary

Breast cancer has changed from its initial perception of being a death sentence. With the advances in breast cancer clinical research over the years, the survival rates have improved vastly. The five-year breast cancer survival rates have increased from ~40% in 1954 to ~89% in 2012, whereas the ten-year breast cancer survival rates have increased from ~25% in 1954 to ~82% in 2012 (American Cancer Society). Breast cancer is now considered as a chronic condition and is generally managed with a combination of surgical treatments to remove the tumor and systemic treatments to prevent tumor recurrence. The current project examined three key issues of importance for effective breast cancer management in the economically underprivileged Medicaid population. Medicaid is one of the largest healthcare payer systems in the United States (US) covering over 60 million low-income individuals.

The first study in this project determined the healthcare utilization and costs associated with breast cancer in the women Medicaid population using the data from the 2006-2008 Medicaid analytic extract (MAX) files for 39 states in the US. Information about healthcare use and costs attributable to a disease is useful to program planners in allocating resources for the treatment of patients. Prior study in this area had used state-specific data (Khanna et al. 2011) and hence with the use of national Medicaid data, the current study makes a significant contribution to literature. Breast cancer-related healthcare use in the form of inpatient,

outpatient, and emergency room (ER) visits was determined among women with breast cancer. Outpatient visits were found to be responsible for more than 95% of the breast cancer-related healthcare use. All-cause healthcare use and costs were compared between women with breast cancer and a matched control group of women without breast cancer. It was found that all-cause inpatient, outpatient, and ER visits and total all-cause costs were significantly higher among women with breast cancer as compared to those without breast cancer. The findings of this study are reflective of the significant healthcare burden associated with breast cancer in the Medicaid population.

The second study in this project determined the impact of pre-existing mental illnesses on guideline-consistent breast cancer treatment and breast cancer-related healthcare utilization among Medicaid enrollees diagnosed with breast cancer. It has been reported in previous studies that considerable proportion of women with breast cancer does not receive treatment consistent with the established guidelines (Bloom et al., 2004, Landercasper et al., 2006, Foley et al., 2007, Worthington et al., 2008, Iyengar et al., 2010, Shirvani et al., 2011). An understanding of factors affecting guideline-consistent breast cancer treatment is necessary to increase use of guideline-consistent breast cancer treatment in breast cancer patients. The current study added to literature concerning factors affecting guideline-consistent breast cancer treatment by determining the association between pre-existing mental illnesses and guideline-consistent breast cancer treatment (breast conserving surgery followed by radiation therapy or total mastectomy with or without radiation therapy for Stage I and II breast cancers and chemotherapy for Stages III and IV breast cancers). In addition, the impact of pre-existing mental illnesses on breast cancer-related healthcare use (inpatient, outpatient, and ER visits) was determined. Data from the 2006-2008 Medicaid analytic extract (MAX) files for 39 states were used in this study. Negative

association was observed between pre-existing mental illnesses and guideline-consistent breast cancer treatment. Also, lower number of breast cancer-related outpatient visits were observed among women with breast cancer with pre-existing mental illnesses as compared to those without pre-existing mental illnesses. The results of this study reflect the treatment disparities experienced by women with breast cancer with pre-existing mental illnesses as compared to those without any pre-existing mental illnesses.

The third study in this project determined the prevalence of repeat mammography screening and the associated factors in the national Medicaid population. Routine mammography screening has been associated with early detection of breast cancer and increased survival. Prior studies in this regard involved women belonging to a single state enrolled in either managed care or fee-for-service system (Weir et al., 2011, Bhanegaonkar et al., 2012). The data sources used in this study included the 2006-2008 MAX files for 39 states and the 2010-2011 Area Resource File. Roughly 1.2% of the eligible women were found to have received repeat mammograms during the study period. Impact of various recipient and neighborhood characteristics on repeat mammography screening was determined. In general, the repeat mammography screening rates were found to be higher among women belonging to ethnic minorities as compared to white women. Age, number of outpatient visits during the study period, use of hormone replacement therapy, and routine cervical cancer screening were positively associated, whereas number of ER visits during the study period were negatively associated with receipt of repeat mammography screening. The findings of this study could be useful for designing strategies aimed at improving repeat mammography screening rates in the women Medicaid population.

Study significance

Significance of study 1: Healthcare burden associated with breast cancer in the Medicaid program

An understanding of the healthcare burden associated with breast cancer in the Medicaid population could be helpful for policy-makers for allocation of resources for breast cancer management in the Medicaid population. Information about current estimates of the breast cancer burden in the Medicaid population is crucial considering the Medicaid expansion under Patient Protection and Affordable Care Act (PPACA), due to which alterations in Medicaid financing are expected in the coming years (Kaiser Family Foundation). The significant healthcare burden of breast cancer in the Medicaid population demonstrated in this study could trigger actions aimed at reducing the morbidity and mortality associated with breast cancer from the Medicaid policy-makers such as interventions aimed at improving breast cancer screening rates and increasing awareness about breast cancer and its risk factors. The estimates of breast cancer-related healthcare utilization and costs obtained in this study can act as a benchmark on which the effectiveness of future healthcare interventions can be evaluated.

Significance of study 2: Impact of pre-existing mental illnesses on receipt of guideline-consistent breast cancer treatment and breast cancer-related healthcare utilization

An understanding of the association between pre-existing mental illnesses and receipt of guideline-consistent breast cancer treatment and breast cancer-related healthcare utilization could be of significant aid to policy-makers in developing strategies oriented towards ensuring adequate treatment of breast cancer patients. The negative association between pre-existing mental illness and guideline-consistent breast cancer treatment and breast cancer-related

healthcare use observed in this study indicates the need of more focused care of breast cancer patients with pre-existing mental illnesses. Strategies such as physician counseling, healthcare skills training, peer-led counseling and help in accessing healthcare, and support from family members have been found to improve healthcare in individuals with mental illnesses and could become the standard of care in these individuals (Lawrence and Kisely, 2010). Some mental illnesses such as depression can go undetected. Therefore, screening for such illnesses could become a crucial aspect of breast cancer management. Findings from this study could also encourage important cancer organizations such as American Society of Clinical Oncology (ASCO) and National Comprehensive Cancer Network (NCCN) to develop separate guidelines for management of breast cancer in patients with mental illnesses. Considering the fact that the prevalence of mental illnesses among Medicaid enrollees is as high as 48% (Adelmann, 2003), the findings of this study are of significant relevance to the Medicaid policy-makers.

Significance of study 3: Factors associated with repeat mammography screening among women enrolled in Medicaid

Regular mammography screening has been found to be associated with earlier detection of breast cancer and improved survival as opposed to irregular or no mammography screening (Freedman et al., 2003, Moss et al., 2006, Hellquist et al., 2010). Information about rates of repeat mammography screening obtained in the Medicaid population can help the policymakers in setting new goals for mammography screening in the Medicaid population. Information about the current repeat mammography screening rates can also act as a benchmark on which the effectiveness of future interventions can be evaluated. Information about factors affecting repeat mammography screening among Medicaid enrollees obtained in this study can help the policy-

makers in planning and designing interventions aimed at increasing the repeat mammography screening rates in the Medicaid population.

Limitations

The limitations specific to each of the three studies in this project have been discussed in detail previously. However, a summary of the overall limitations has been discussed below. Coding errors are possible while processing of administrative claims, which could have impacted the results of this project. The MAX data for some of the states were not available at the time of the study and hence findings of this project are not generalizable to the entire Medicaid population in the US. Further, dual-eligibles, i.e., recipients enrolled in Medicaid and Medicare, were not included in the project since Medicare is the primary payer for these individuals and complete information about their medical care is not contained in the MAX files. Hence the results obtained from this project are not representative of the Medicaid population belonging to the 39 states considered in this study. Details about the specialty of the physician providers were not available in the MAX files, due to which certain variables concerning physician specialty could not be included in this project. Details such as the date of cancer diagnosis, stage of cancer at diagnosis, and the clinical characteristics of cancer including the hormone receptor, lymph node, and Human Epidermal Growth Factor Receptor 2 status were not available in the MAX files. Therefore, in study 1, it was not possible to distinguish between newly diagnosed and prevalent cases of breast cancer and compare the breast cancer-related healthcare use among different demographic sections of the population. In study 2, for the same reason, the newly diagnosed cases of breast cancer and the cancer stage at diagnosis were identified using established algorithms developed by Solin et al. (1994) and Yuen et al. (2011). Though these algorithms

have been found to have favorable measurement properties in different patient populations, they have not been validated in the Medicaid population. Further, some of the established breast cancer treatment guidelines, including use of chemotherapy for lymph node-positive breast cancer, endocrine therapies for estrogen receptor-positive cancers, and tissue-targeted therapies for Human Epidermal Growth Factor Receptor 2-positive breast cancer, were not considered while determining guideline-consistent breast cancer treatment. Details about the costs associated with each encounter record were not available for the Medicaid managed care enrollees. Hence, analyses concerning breast cancer-specific costs could not be incorporated in this project.

Directions for future research

Considering the unavailability of the information concerning clinical characteristics of the cancer in the MAX files, future studies could link data from state tumor registries and the MAX data to answer certain important questions concerning breast cancer in the Medicaid population. Breast cancer-related healthcare use by phase and stage of breast cancer could be studied longitudinally among Medicaid enrollees. The tumor registry-linked Medicaid administrative claims data will make it possible to exhaustively define guideline-consistent breast cancer treatment based on hormone receptor and lymph node status of the tumor. It will be interesting to see if the negative association between and pre-existing mental illnesses and guideline-consistent breast consistent treatment observed in this study holds true in that context as well. Future studies could evaluate the effectiveness of various healthcare interventions aimed at improving breast cancer treatment in breast cancer patients with pre-existing mental illnesses. Survey research techniques could be used to understand the impact of psychological factors such as perceived risk of breast cancer

and views about benefits of mammography and other factors such as recommendation from a physician and family history of breast cancer on routine mammography screening in the Medicaid population in future studies.

LIST OF REFERENCES

1) Adelmann PK. Mental and substance use disorders among Medicaid recipients: prevalence estimates from two national surveys. Adm Policy Ment Health 2003;31:111-129.
2) American Cancer Society. Breast cancer facts and figures 2011-2012. Available at: http://www.cancer.org/acs/groups/content/@epidemiologysurveilance/documents/document/acspc-030975.pdf. Accessed April 30, 2012.
3) Bhanegaonkar A, Madhavan SS, Khanna R, Remick RC. Declining mammography screening in a state Medicaid fee-for-service program: 1999-2008. J Womens Health 2012;21:821-829.
4) Bloom BS, de Pouvourville N, Chhatre S, Jayadevappa R, Weinberg D. Breast cancer treatment in clinical practice compared to best evidence and practice guidelines. Br J Cancer 2004;90:26-30.
5) Foley KL, Kimmick G, Camacho F, Levine EA, Balkrishnan R, Anderson R. Survival disadvantage among Medicaid-insured breast cancer patients treated with breast conserving surgery without radiation therapy. Breast Cancer Res Treat 2007; 101:207-214.
6) Freedman GM, Anderson PR, Goldstein LJ et al. Routine mammography is associated with earlier stage disease and greater eligibility for breast conservation in breast carcinoma patients age 40 years and older. Cancer 2003;98:918-925.
7) Hellquist BN, Duffy SW, Abdsaleh S, et al. Effectiveness of population- based service screening with mammography for women ages 40 to 49 years. Cancer 2011;117:714-722.
8) Iyengar R, Lund MJ, Lamson P, et al. Using National Quality Forum breast cancer indicators to measure quality of care for patients in an AVON comprehensive breast center. Breast J 2010;16:240-244.
9) Kaiser Family Foundation. Medicaid Coverage and Spending in Health Reform: National and state-by-state results for adults at or below 133% FPL. Available at http://www.kff.org/healthreform/upload/medicaid-coverage-and-spending-in-health-reform-national-and-state-by-state-results-for-adults-at-or-below-133-fpl.pdf. Accessed July 18, 2012.
10) Khanna R, Madhavan SS, Bhanegaonkar A, Remick SC. Prevalence, healthcare utilization, and costs of breast cancer in a state Medicaid fee-for-service program. J Womens Health 2011;20:739-747.
11) Landercasper, Dietrich LL, Johnson M. A breast cancer review of compliance with National Comprehensive Cancer Network Breast Cancer guidelines. Am J Surg 2006;192:525-527.
12) Lawrence D, Kisely S. Review: Inequalities in healthcare provision for people with severe mental illness. J Psychopharmacol 2010;24:61-68.
13) Moss SM, Cuckle H, Evans A, Johns L, Waller M, Bobrow L. Effect of mammographic screening from age 40 years on breast cancer mortality at 10 years' follow-up: a randomised controlled trial. Lancet 2006;368:2053-2060.
14) Shirvani SM, Pan IW, Buchholz TA, Shih YCT, Hoffman KE, Giordano SH, Smith BD. Impact of evidence- based clinical guidelines on the adoption of postmastectomy radiation in older women. Cancer 2011;117:4595-4605.
15) Solin LJ, Legorreta A, Schutz DJ, Levin HA, Zatz S, Goodman RL. Analysis of a claims database for the identification of patients with carcinoma of the breast. J Medical System 1994;18:23-32.

16) Weir S, Posner HE, Jones WC, Willis G, Baxter JD, Clark RE. Disparities in routine breast cancer screening for Medicaid managed care members with a work-limiting disability. Medicare Medicaid Res Rev 2011;1.
17) Worthington J, Waterbor JW, Funkhouser E, Falkson C, Cofield S, Fouad M. Receipt of standard breast cancer treatment by African American and White women. Int J Med Sci 2008;5:181-188.
18) Yuen E, Louis D, Cisbani L, et al. Using administrative data to identify and stage breast cancer cases: implications for assessing quality of care. Tumori 2011;97:428-425.

LIST OF APPENDICICES

Appendix 1. Yuen's algorithm for breast cancer staging

American Joint Committee on Cancer breast cancer stage	International Classification for Diseases, ninth revision, clinical modification codes
0	233.0
I	233.0 and 174.0-174.9
II	233.0, 174.0-174.9, and 196.3
III	233.0, 174.0-174.9, 196.3, 196.0, and 198.2
IV	233.0, 174.0-174.9, 196.3, 196.0, 198.2, 196.1-196.2, 196.5-196.6, 196.8-196.9, 197.0-197.8, 198.0-198.1, 198.3-198.7, and 198.81-198.82.

VITA

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AREAS OF EXPERTISE

- Primary expertise in conducting research in health services and outcomes using secondary databases such as Medicare 5% national administrative claims data, Medicaid Analytic Extract files, Behavioral Risk Factor Surveillance System (BRFSS), and Healthcare Cost and Utilization Project Nationwide Inpatient Sample (HCUP-NIS).
- Experience in patient-reported outcomes research and pharmacoeconomic modeling.
- Experience in working across all stages of a project including systematic literature review, conceptualization of research objectives, designing research methodology, data management and analysis, report writing, and performing quality checks.
- Strong statistical background with knowledge of multivariable regression techniques, multilevel modeling, survival analysis, and risk adjustment techniques such as propensity score matching.
- Proficiency in using statistical software, including SAS and SPSS.

ACADEMIC CREDENTIALS

August 2010 – Current
Doctor of Philosophy (Ph.D.) in Pharmacy Administration (Emphasis: Health Services and Outcomes Research), Department of Pharmacy Administration, School of Pharmacy, University of Mississippi, University, MS 38677
Dissertation title: Management of breast cancer in the Medicaid population

August 2006 – December 2008
Master of Science (M.S.) in Pharmacy Administration, Department of Pharmacy Administration and Allied Health Sciences, School of Pharmacy, St. John's University, NY 11439
Non-thesis project: Consumer reactions to Food and Drug Administration (FDA) public advisory about pediatric over-the-counter cough and cold medications

September 2002 – May 2006

Bachelor of Technology (B.Tech.) in Pharmaceuticals and Fine Chemicals, Department of Pharmaceutical Sciences and Technology, Institute of Chemical Technology, Mumbai 400019, India

WORK EXPERIENCE

January 2012 – Present
Research Assistant, The Mississippi Evidence-based Drug Utilization Review (DUR) Initiative, Center for Pharmaceutical Marketing and Management, University of Mississippi

- Responsibilities include analyzing pharmacy and medical claims data to evaluate the quality of care delivered to Mississippi Medicaid beneficiaries and creating reports for the same deliverable to Mississippi Division of Medicaid

December 2009 – June 2010
Management Trainee, Emcure Pharmaceuticals, Pune, India

- Contributed to designing promotional strategies and managed local sales for a top-selling thrombolytic drug of a multinational pharmaceutical industry

July 2009 – December 2009
Analyst, StrataPRO Analytics, Bengaluru, India

- Contributed to projects in pharmaceutical market assessment and drug pipeline analysis for multinational pharmaceutical industries

PUBLICATIONS

Khanna R, Jariwala K, West-Strum D, **Mahabaleshwarkar R**. Health-related quality of life and its determinants among adults with autism. Accepted for publication in *Research in Autism Spectrum Disorders*.

Mahabaleshwarkar R, Khanna R. National hospitalization burden associated with spinal cord injuries in the United States. Accepted for publication in *Spinal Cord.*

Mahabaleshwarkar R, Khanna R, West-Strum D, Yang Y. Association between health-related quality of life and colorectal cancer screening. *Population Health Management* 2013;16(3):178-189.

Mahabaleshwarkar RK, Yang Y, Datar MV, Bentley JP, Strum MW, Banahan BF, Null KD. Risk of adverse cardiovascular outcomes and all-cause mortality associated with concomitant use of clopidogrel and proton pump inhibitors in elderly patients. *Current Medical Research and Opinion* 2013;29(4):1-9.

Datar M, Yang Y, **Mahabaleshwarkar R**, Bentley JP, Banahan BF. Comparative effectiveness of on-pump versus off-pump coronary artery bypass grafting among elderly patients: a

propensity score-matched analysis. *Health Outcomes Research in Medicine* 2012;4(3):e221-e230.

Khanna R, Pace PF, **Mahabaleshwarkar R**, Basak , Datar M, Banahan B. Medication adherence for chronic diseases among recipients enrolled in a state Medicaid program. *Population Health Management* 2012;15(5):253-260.

PRESENTATIONS

Mahabaleshwarkar R, Khanna R, West-Strum D, Yang Y. "Association between health-related quality of life and colorectal cancer screening." Podium presentation at the University of Mississippi Medical Center Cancer Research Day, November 19, 2012, Jackson, MS.

Yang Y, Datar MV, Bentley JP, Banahan BF, **Mahabaleshwarkar R**. "Clinical and economic outcomes associated with on-pump versus off-pump coronary artery bypass grafting (CABG) in high risk elderly patients." Poster presentation at the Academy Health Annual Research Meeting, June 24-26, 2012, Orlando, FL.

Datar M,Yang Y, Bentley JP, Banahan BF, **Mahabaleshwarkar R**. "Economic outcomes associated with on-pump versus off-pump coronary artery bypass grafting (CABG) in high risk elderly patients." Podium presentation at the Southern Pharmacy Administration Conference, June 22-24, 2012, Austin, TX.

Datar M, Yang Y, **Mahabaleshwarkar R**, Bentley JP, Banahan BF. "Comparative Effectiveness of On-Pump and Off-Pump Coronary Artery Bypass Grafting Among Elderly Patients – a Retrospective Analysis of Medicare Claims Data." Podium presentation at the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) 17th Annual International Meeting, June 2-6, 2012, Washington, DC. (Abstract citation: *Value in Health* 2012;15(4):A4).

Mahabaleshwarkar R, Yang Y, Datar M, Bentley JP, Strum M, Banahan BF, Null KD. "Risk of adverse cardiovascular outcomes associated with concomitant use of clopidogrel and proton pump inhibitors in elderly Medicare beneficiaries." Podium presentation at the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) 17th Annual International Meeting, June 2-6, 2012, Washington, DC. (Abstract citation: *Value in Health* 2012;15(4):A112).

Mahabaleshwarkar R, Khanna R. "National inpatient burden associated with spinal cord injuries in the United States." Poster presentation at the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) 17th Annual International Meeting, June 2-6, 2012, Washington, DC. (Abstract citation: *Value in Health* 2012;15(4):A80).

Mahabaleshwarkar R, Yang Y, Datar M, Bentley JP, Strum M, Banahan BF, Null KD. "Risk of adverse cardiovascular outcomes associated with concomitant use of clopidogrel and proton pump inhibitors in elderly Medicare beneficiaries." Poster presentation at the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) 17th Annual International

Meeting, June 2-6, 2012, Washington, DC. (Abstract citation: *Value in Health* 2012;15(4):A112).

Ramachandran S, **Mahabaleshwarkar R**, Yang Y. "Cost effectiveness analysis of addition of telaprevir or boceprevir to standard therapy versus standard therapy alone for the treatment of previously untreated chronic hepatitis C virus genotype 1 infection." Poster presentation at the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) 17th Annual International Meeting, June 2-6, 2012, Washington, DC. (Abstract citation: *Value in Health* 2012;15(4):A242).

Datar M, Khanna R, Pace P, **Mahabaleshwarkar R**, Basak R, Banahan B. "Medication adherence among patients with rheumatoid arthritis." Poster presentation at the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) 17th Annual International Meeting, June 2-6, 2012, Washington, DC. (Abstract citation: *Value in Health* 2012;15(4):A40).

Khanna R, Datar M, Pace P, **Mahabaleshwarkar R**, Basak R, Banahan BF III. "Assessing medication adherence and its impact on acute care services utilization among recipients with chronic conditions in a state Medicaid program." Poster presentation at the American Pharmacists' Association (APhA) Annual Meeting and Exposition, March 9-12, 2012, New Orleans, LA. (Abstract citation: *Journal of American Pharmacists Association* 2012;52(2):200).

Mahabaleshwarkar R, Banahan BF. "Effect of Medicare part D coverage gap on medication consumption behaviors: case of oral anti-diabetic medications." Poster presentation at the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) 16th Annual International Meeting, May 21-25, Baltimore, MD. (Abstract citation: *Value in Health* 2011;14(3):A102).

GRANTS

Health-related quality of life and its determinants in adults with autism spectrum disorders
Amount: $28,368
Agency: Organization of Autism Research
Role: Co-investigator
Status: Funded, ongoing

Retrospective analysis of medication adherence among Medicaid beneficiaries: an evaluation across six chronic diseases
Agency: Drug Information Association
Role: Co-investigator
Status: Unfunded, complete

Using Medicare/Medicaid claims data to support medication outcomes and pharmacovigilance research
Amount: $500,000
Agency: Center for Medicare and Medicaid Services

Role: Co-investigator
Status: Funded, complete

ACHIEVEMENTS

2013 **Research Paper of the Year Award:** The University of Mississippi Department of Pharmacy Administration Award for the most outstanding research article published by a graduate student during the academic year 2012-2013.

2013 **Graduate School Dissertation Fellowship Award:** The University of Mississippi Graduate School non-service fellowship for supporting dissertation research.

2012 **Best Student Poster Presentation Award - Mahabaleshwarkar R,** Khanna R. "National inpatient burden associated with spinal cord injuries in the United States." International Society for Pharmacoeconomics and Outcomes Research (ISPOR) 17th Annual International Meeting, June 2-6, 2012, Washington, DC.

2012 **Best Poster Finalist - Mahabaleshwarkar R,** Yang Y, Datar M, Bentley JP, Strum M, Banahan BF, Null KD. "Risk of adverse cardiovascular outcomes associated with concomitant use of clopidogrel and proton pump inhibitors in elderly Medicare beneficiaries." International Society for Pharmacoeconomics and Outcomes Research (ISPOR) 17th Annual International Meeting, June 2-6, 2012, Washington, DC.

2012 **Student Research Showcase - Mahabaleshwarkar R,** Yang Y, Datar M, Bentley JP, Strum M, Banahan BF, Null KD. "Risk of adverse cardiovascular outcomes associated with concomitant use of clopidogrel and proton pump inhibitors in elderly Medicare beneficiaries." International Society for Pharmacoeconomics and Outcomes Research (ISPOR) 17th Annual International Meeting, June 2-6, 2012, Washington, DC: **research selected among only four studies in health economics and outcomes research having a high impact on future healthcare decisions for a special podium presentation.**

2012 **Annual International Meeting Grant**: The University of Mississippi-International Society for Pharmacoeconomics and Outcomes Research (ISPOR) student chapter award for performance in health outcomes research.

2012 Inducted into **Chi Chapter of Rho Chi Pharmaceutical Honor Society**
School of Pharmacy, University of Mississippi.

2011 **Best Poster Finalist - Mahabaleshwarkar R**, Banahan BF. "Effect of Medicare part D coverage gap on medication consumption behaviors: case of oral anti-diabetic medications." International Society for Pharmacoeconomics and Outcomes Research (ISPOR) 16th Annual International Meeting, May 21-25, Baltimore, MD.

RELEVANT COURSEWORK

Health Outcomes: Secondary Data Techniques, Pharmacoepidemiology, Public and Private Healthcare Systems, Research Methods, Health Outcomes Assessment, Pharmacoeconomics

Statistical Analysis: Biostatistics, General Linear Models, Applied Multivariate Analysis, Data Management and Analytical Software, Applied Longitudinal Modeling

COMPUTER SKILLS

Statistical Software (SAS, SPSS), Decision Analytic Software (TreeAge), Survey Software (Qualtrics), Microsoft Office (Word, PowerPoint, Excel)

PROFESSIONAL AFFILIATIONS

Rho Chi Pharmaceutical Honor Society, 2012 – Present
International Society for Pharmacoeconomics and Outcomes Research, 2011 – Present
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